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TECHNICAL REVIEW OF THE CITY OF NEW BEDFORD (MASSACHUSETTS) SECTION 301(h) APPLICATION FOR MODIFICATION OF SECONDARY TREATMENT REQUIREMENTS FOR DISCHARGE INTO MARINE WATERS

by

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for

U.S. Environmental Protection Agency

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I. INTRODUCTION

This document is a technical evaluation of the City of New Bedford revised application for a modification of secondary treatment requirements submitted on December 2, 1983. The evaluation is based on information provided in the revised Section 301(h) application, appended materials, and the modified NPDES permit application submitted at that time. Information solicited from federal, state, and regional agency staff is also incorporated where appropriate. The format followed herein is that of the Large Applicant Questionnaire published on November 26, 1982, in the applicable Final Rule (FR53666).

The application is based on an improved discharge to a saline estuary. The 1982 annual average flow rate of 1.00 m^3/sec (22.8 MGD) is projected to be the same in 1984. Requested effluent limitations at average flow conditions are 81 mg/l BOD_5, 50 mg/l suspended solids, and a pH range of 6.0 to 9.0. For a projected 1989 annual average flow of 1.19 m^3/sec (27.0 MGD), the BOD_5 mass emission rate for the proposed discharge is expected to be 8,279 kg/day (18,251 lb/day), and the corresponding suspended solids mass emission rate is expected to be 5,110 kg/day (11,266 lb/day). Industrial flow is estimated to be 15.8 percent of the 1982 annual average flow. Combined sewers comprise approximately 60 percent of the collection system. The applicant estimates that 215 overflows occur annually, amounting to 6.55×10^6 m^3 (1.73×10^9 gal) of combined discharge to Clarks Cove, inner New Bedford Harbor, and outer New Bedford Harbor. Seventy priority pollutants and pesticides were detected in the effluent in 1979, and seven exceeded the available criteria for the protection of saltwater aquatic life following the minimum initial dilution for the proposed discharge. More recent analyses (1983) exhibit lower concentrations of toxic pollutants. For the proposed discharge, copper would exceed the available saltwater criteria, with potential violations for mercury, nickel, and PCBs. The existing outfall discharges in 9 m (29.5 ft) of water, approximately 910 m (2,986 ft) from shore. The proposed outfall extension and diffuser will discharge in 12 m (39.4 ft) of water, terminating approximately 6,670 m (21,880 ft) from Clarks Point, its point of origin, and 4,200 m (13,780 ft) from Round Hill Point, the nearest shore.

Compared to the 1979 application, the 1983 application is for a lower BOD_5 effluent limitation (81 mg/l now vs. 97 mg/l then), lower projected flows, improved solids removal processes, and a redesigned outfall/diffuser system. As a result, the initial dilutions achieved are lower. Also, the 1989 end-of-permit-term mass emission rate for BOD_5 is approximately 23 percent lower than previously projected for 1990, and the corresponding suspended solids mass emission rate is 8 percent lower.

II. *GENERAL INFORMATION AND BASIC DATA REQUIREMENTS*

A. *Treatment System Description*

1. *Are you applying for a modification based on a current discharge, improved discharge, or altered discharge as defined in 40 CFR 125.58? [40 CFR 125.59(a)]*

The 301(h) application submitted by the City of New Bedford is based on an improved discharge.

2. *Description of the Treatment/Outfall System [40 CFR 125.61(a) and 125.61(e)]*

The general locations of the New Bedford existing and proposed outfalls are shown in Figure 1. The primary treatment facility presently serves a population of 101,000 from New Bedford, Acushnet, and Dartmouth. Current treatment consists of grit removal, screening, primary settling, and disinfection. Sludge is degritted, thickened, dewatered in centrifuges, and incinerated. Ash is disposed of at a landfill. Effluent is chlorinated and discharged to Buzzards Bay through a single 1.52-m (60-in) port at 41° 35' 07" N latitude and 70° 53' 37" W longitude. Additional discussion of the existing treatment facility and outfall may be found in the previous Technical Evaluation Report (TER) (Tetra Tech 1981).

The applicant proposes treatment system improvements to increase process flexibility, enhance settling and solids removal, and augment solids handling

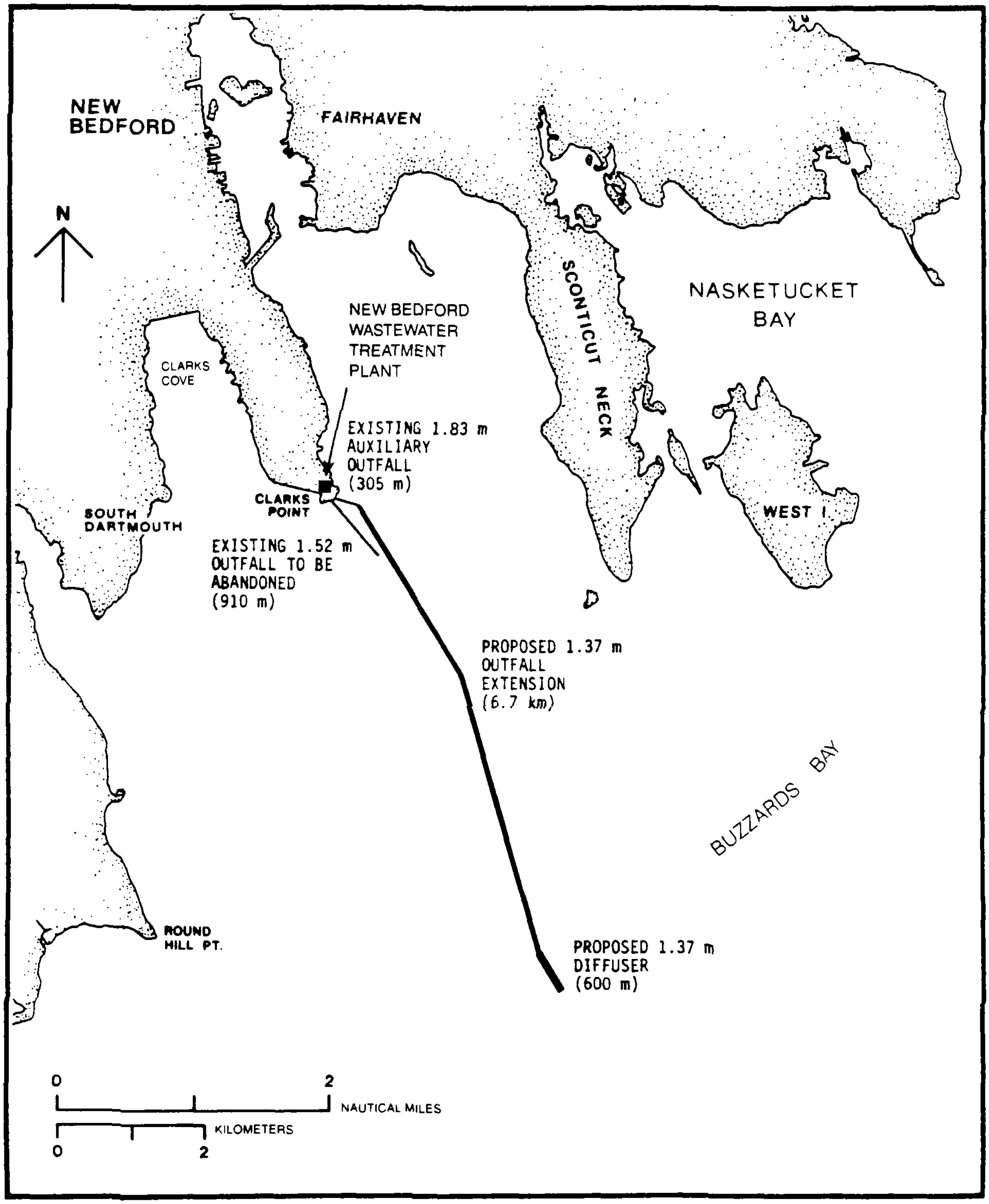


Figure 1. Location of existing and proposed outfalls for the New Bedford Wastewater Treatment Plant.

capacity. Improvements recommended in a 1974 facilities report include:

- New aerated grit removal facilities
- New polymer addition system
- New sludge pumping station and tunnel
- Additional sludge handling systems
- Grease and scum removal improvements
- Sludge dewatering system modifications
- Chlorination system modifications.

With the exception of the polymer addition system, the above improvements are in the Step II design phase. The applicant expects state authorization to proceed with construction in February, 1984. A schedule for the planning, design, and construction of the modified discharge facilities is provided in the NPDES permit application, but it is not clear if this schedule applies to the proposed polymer addition modification. The schedule calls for completion of all primary facilities and outfall modifications by March, 1989.

The proposed outfall modifications consist of abandoning the existing outfall and extending the present auxiliary outfall. The auxiliary outfall is currently used to discharge excess storm flow. The existing auxiliary outfall is a 1.83-m (72-in) pipe extending 305 m (1,000 ft) from shore to a depth of 7.3 m (24 ft). The proposed modification would extend this outfall to a length of 7,000 m (22,966 ft). Effluent would be discharged through a new 600-m (1,969-ft) diffuser with 20 ports.

3. *Effluent Limitations and Characteristics [40 CFR 125.60(b) and 125.61(e)(2)]*

The applicant requests the following final effluent limitations at average flow conditions:

Biochemical oxygen demand	81 mg/l
Suspended solids	50 mg/l
pH	6 to 9

These limitations represent a 40 percent removal of influent BOD_5 (135 mg/l) and a 60 percent removal of influent suspended solids (124 mg/l). The applicant also states that the application is based on a total discharge design flow of 1.31 m^3/sec (30 MGD).

Effluent characteristics for the existing and proposed discharges are shown in Table 1. Priority pollutants detected in wet- and dry-weather effluent samples collected in 1979 are shown in Table 36 of Tetra Tech (1981). Fifty-six organic compounds, 13 metals, and cyanide were detected. The results of more recent effluent analyses are given in Table 2 herein. While all 13 priority pollutant metals were found in detectable concentrations, the number of other detectable priority pollutants was reduced to nine. The applicant states that, although conclusive proof of an overall reduction in effluent toxic pollutants is not yet available, the evidence suggests that some compounds (PCBs in particular) have been reduced by the sewage system cleanup described in Section III.D.4 of the application. This effort included the removal of PCB-contaminated soils at two industrial sites and the cleanout of contaminated sediment deposits in sewer lines. If it is assumed that the 1983 effluent concentrations are typical of the modified discharge, then copper is the only quantifiable toxic pollutant that will exceed U.S. EPA water quality criteria following initial dilution. However, other toxic pollutants detected at concentrations below quantitation limits, such as mercury and nickel, may also exceed the EPA criteria following initial dilution. For these metals, the quantitation limit exceeded the EPA criteria following initial dilution. Furthermore, although PCBs were not detected in the 1983 dry- and wet-weather samples, the detection limits were 10 and 1 ug/l, respectively. With an initial dilution of 26.5:1, effluent PCB concentrations exceeding 0.795 ug/l would cause a violation of the EPA 24-h saltwater aquatic life criterion of 0.030 ug/l after initial

TABLE 1. EFFLUENT CHARACTERISTICS FOR THE EXISTING AND PROPOSED NEW BEDFORD WASTEWATER TREATMENT PLANT DISCHARGE

	Existing[a]	Proposed[b]
Plant Flow [m^3/sec (MGD)]:		
- Minimum	0.44 (10.0)	0.44 (10.0)
- Average dry weather	0.86 (19.5)	0.86 (19.5)
- Average wet weather	1.48 (33.7)	1.48 (33.7)
- Annual average	1.00 (22.8)	1.00 (22.8)
- Maximum	1.76 (40.0)	1.76 (40.0)
BOD_5 (mg/l) for:		
- Minimum plant flows	113	93
- Average dry weather plant flows	110	91
- Average wet weather plant flows	75	65
- Annual average plant flows	102	81
- Maximum plant flows	58	53
Dissolved Oxygen (mg/l) for:		
- Minimum plant flows	9.0	9.0
- Average dry weather plant flows	9.0	9.0
- Average wet weather plant flows	9.0	9.0
- Annual average plant flows	9.0	9.0
- Maximum plant flows	9.0	9.0
Suspended Solids (mg/l) for:		
- Minimum plant flows	118	61
- Average dry weather plant flows	113	54
- Average wet weather plant flows	85	37
- Annual average plant flows	108	50
- Maximum plant flows	64	26
pH		
- Minimum		6.0
- Maximum		9.0

[a] Based on 1982 plant operating records.

[b] Effluent concentrations are based on 60 percent removal of suspended solids and 40 percent removal of BOD_5. Influent values are based on 1982 plant data.

TABLE 2. PRIORITY POLLUTANTS DETECTED IN RECENT EFFLUENT SAMPLES

Priority Pollutant	Concentration, ug/l Dry Weather (June 15-16, 1983)	Wet Weather (August 11-12, 1983)
1,1,1-trichloroethane	34	14
chloroform	ND[a]	7
ethylbenzene	19	ND
bis(2-ethylhexyl) phthalate	70	21
di-n-octyl phthalate	13	ND
tetrachloroethylene	ND	6
toluene	20	26
trichloroethylene	20	8
antimony	<50[b]	<25
arsenic	<25	<10
beryllium	<100	<50
cadmium	<100	<25
chromium	120	200
copper	270	320
lead	20	<50
mercury	<5	<1
nickel	<200	100
selenium	<50	<25
silver	<50	<50
thallium	<50	<50
zinc	240	250
cyanide	<40	<10

[a] Not detected. Concentration is below analytical detection limit.

[b] Indicates that concentration is less than 50 ug/l, but is present.

mixing. Therefore, it is possible that PCBs are still present in the effluent in sufficient concentration to violate EPA water quality criteria. It is noteworthy that analyses of 1982 treatment plant composite effluent samples (three 5-day periods in March) indicated PCB concentrations of up to 5.7 ug/l (Weaver 1982). For samples from a 5-day June sampling period, PCB concentrations as high as 10 ug/l were recorded (Weaver, G., 16 March 1984, personal communication).

Based on the outcome of polymer addition pilot tests conducted on the raw influent, the applicant expects increased treatment plant removal efficiencies for metals (including copper) in the modified discharge. The applicant also predicts further reduction of effluent toxic compound concentrations when the industrial pretreatment program is implemented. However, the expected degree of reduction is not documented in the revised application.

4. *Effluent Volume and Mass Emissions [40 CFR 125.61(e)(2) and 125.65]*

The applicant provides projected existing and improved mass emission rates for 5-year increments in Tables IA4 and IA5 of the revised application. The results of calculations performed during this review (Table 3) are in close agreement with the applicant's projections. The current (1982) annual average effluent suspended solids concentration of 108 mg/l exceeds the existing NPDES permit effluent limitation of 80 mg/l. Therefore, the current mass emission rates were calculated using the current annual average effluent concentrations of 102 mg/l BOD_5 and 108 mg/l suspended solids. Mass emission rate projections (1984-1999) assume that effluent limitations will be met. Compared to the mass emission rates projected under the existing operational mode, the projected mass emission rates of the improved discharge are 26 percent lower for BOD_5 and 38 percent lower for suspended solids. The proposed treatment system improvements are expected to lead to end-of-permit term (1989) mass emission rates that are lower than current rates. The proposed 1989 BOD_5 mass emission rate of 8,279 kg/day (18,251 lb/day) is 6 percent lower than the actual 1982 mass emission rate of 8,807 kg/day (19,416 lb/day). The proposed 1989 suspended solids mass emission rate

TABLE 3. CURRENT AND PROJECTED EFFLUENT VOLUMES AND MASS EMISSION RATES

Parameter	1982 Current[a]	1984 Existing[b]	1984 Proposed[c]	1989 Existing	1989 Proposed	1994 Existing	1994 Proposed	1999 Existing	1999 Proposed
Annual average flow									
m^3/sec	1.00	1.00		1.19		1.28		1.32	
MGD	22.81	22.81		27.00		29.00		30.00	
Suspended solids									
mt/yr	3,404	2,521	1,576	2,984	1,865	3,206	2,003	3,316	2,073
1,000 lb/yr	7,504	5,558	3,474	6,579	4,112	7,067	4,417	7,310	4,569
kg/day	9,325	6,908	4,317	8,176	5,110	8,782	5,489	9,085	5,678
lb/day	20,558	15,228	9,518	18,026	11,266	19,361	12,101	20,029	12,518
Biochemical oxygen demand									
mt/yr	3,215	3,467	2,553	4,104	3,022	4,408	3,246	4,560	3,358
1,000 lb/yr	7,087	7,463	5,628	9,047	6,662	9,717	7,155	10,052	7,402
kg/day	8,807	9,498	6,994	11,243	8,279	12,075	8,892	12,492	9,199
lb/day	19,416	20,939	15,419	24,786	18,251	26,621	19,603	27,539	20,279

[a] Annual average BOD_5 concentration of 102 mg/l; suspended solids concentration of 108 mg/l.

[b] Existing NPDES permit effluent BOD_5 limitation of 110 mg/l; suspended solids limitation of 80 mg/l.

[c] Annual average BOD_5 concentration of 81 mg/l; suspended solids concentration of 50 mg/l.

of 5,110 kg/day (11,266 lb/day) is 45 percent lower than the actual 1982 mass emission rate of 9,325 kg/day (20,558 lb/day).

The applicant projects the 1984 annual average flow of 1.00 m^3/sec (22.8 MGD) to rise to 1.19 m^3/sec (27.0 MGD) by 1989, representing an 18 percent increase. However, the service area population is not expected to change during the 5-year permit term. The present (1982) combined population served by the treatment facility is 101,000. Increases in annual average flow are expected to be due solely to the rerouting of combined sewer overflows to the treatment system. The maximum month (June) dry weather season flow is projected to be 1.24 m^3/sec (28.2 MGD).

5. *Average Daily Industrial Flow (m^3/sec) (40 CFR 125.64) Provide or estimate the average daily industrial inflow to your treatment facility for the same time increments as in question II.A.4.a above.*

Approximately 200 "business operations" are connected to the New Bedford wastewater treatment plant, according to the applicant. In the 1974 Facility Plan, the total industrial flow was assumed to be 0.276 m^3/sec (6.3 MGD). More recent (1982) data place the industrial flow at 0.158 m^3/sec (3.6 MGD), a decrease of 43 percent. Probable causes cited by the applicant for this decrease are the increasing awareness of the need for water conservation and business closures. The applicant predicts that industrial flow will remain constant at 0.158 m^3/sec (3.6 MGD) for the duration of the 20-year planning period. This represents a decline from 15.8 percent of the annual average flow in 1984 to 12.0 percent in 1999.

6. *Combined Sewer Overflows [40 CFR 125.65(b)]*

The locations, NPDES permit reference numbers, sizes, and receiving waters of the combined sewer overflows are listed in Table IA7 of the application. Forty-one outlets are listed, discharging to Clarks Cove, outer New Bedford Harbor, inner New Bedford Harbor, and the Acushnet River. Approximately 47 percent of the treatment plant's service area is served by combined sewers. Computer simulations performed by the applicant's consultant estimated that under existing conditions Clarks Cove receives 75 combined sewer overflows per year, outer New Bedford Harbor receives 80 per year, and inner New Bedford Harbor receives 60 per year. A total of 6.55×10^6 m^3 (1.73×10^9 gal) is discharged annually from combined sewer overflows, equivalent to an average daily flow of 0.208 m^3/sec (4.74 MGD). The applicant proposes to reduce the volume of combined sewer overflows through implementation of a maintenance program for the combined sewer system pumping stations, regulators, and sewers, by reconstruction of a pumping station, and by cleaning of an interceptor sewer. Completion of these efforts will reportedly reduce overflows by 9 percent, resulting in a treatment plant influent volume increase of approximately 0.019 m^3/sec (0.43 MGD). Presumably, the additional 0.171 m^3/sec (3.9 MGD) anticipated by 1989 is due to further rerouting of overflows to the treatment plant.

7. *Outfall/Diffuser Design. Provide the following data for your current discharge as well as for the modified discharge, if different from the current discharge: [40 CFR 125.61(a)(1)]*

   - *Diameter and length of the outfall(s) (meters)*
   - *Diameter and length of the diffuser(s) (meters)*
   - *Angle(s) of port orientation(s) from horizontal (degrees)*
   - *Port diameter(s) (meters)*
   - *Orifice contraction coefficient(s), if known*
   - *Vertical distance from mean lower low water (or mean low water) surface and outfall port(s) centerline (meters)*
   - *Number of ports*
   - *Port spacing (meters)*
   - *Design flow rate for each port if multiple ports are used (m^3/sec)*

The physical characteristics of the existing outfall and the proposed outfall and diffuser are listed in Table 4. The hydraulic characteristics of a well-designed diffuser include:

TABLE 4. PHYSICAL CHARACTERISTICS OF THE NEW BEDFORD OUTFALL AND DIFFUSER

Description	Existing	Proposed
Outfall diameter, m (in)	1.52 (60)	1.37 (54)
Outfall length to the diffuser, m (ft)	910 (2,986)	7,000 (22,966)
Diffuser diameter, m (in)	-	1.37 (54)
Diffuser length, m (ft)	-	600 (1,969)
Angle of port orientation from horizontal, degrees	90	90[a]
Port diameter, m (in)	1.52 (60)	0.25 (9.8)
Orifice contraction coefficient	1.00	0.63
Vertical distance from mean low water to port, m (ft)	9 (29.5)	12 (39.4)
Number of ports	1	20
Port spacing, m (ft)	-	30 (98.4)
Design flow rate for each port, m^3/sec (MGD)[b]	-	0.0484 to 0.0551 (1.105 to 1.258)

[a] The applicant states (p. I24 of the revised application) that the ports are to be in the crown of the pipe. However, Figure IIA2 indicates all plumes emanating from the side, but also has +'s for top port locations. Therefore, the latter positions are assumed to be correct herein.

[b] For total flow of 1.0 m^3/sec (22.8 MGD).

- Uniform diffuser port flows

- Minimum velocity in the diffuser pipe should be 0.61 to 0.91 m/sec (2 to 3 ft/sec) at peak flow

- The densimetric Froude number for each port should be greater than 1

- Total area of ports downstream of a diffuser pipe section should not exceed 1/2 to 2/3 of the area of that section.

As part of this review, the diffuser flow distribution was calculated for maximum flows in the range expected over the permit term. Since the treatment plant flow is projected to increase significantly over the permit term (1984 to 1989), the diffuser hydraulics were calculated for the existing maximum flow and the projected 1989 maximum flow. At the existing maximum flow [1.76 m^3/sec (40.0 MGD)], all port Froude numbers were greater than one, the ratio of total port area to diffuser pipe area was 0.666, and port discharges were fairly uniform, varying approximately 9 percent from the shoreward end to the seaward end of the diffuser. However, pipe velocities were below the suggested minimum velocity [0.61 m/sec (2 ft/sec)] past the last 11 of 20 ports [representing 301 m (988 ft) of the diffuser]. For the calculated 1989 maximum flow [2.09 m^3/sec (47.8 MGD)], Froude numbers also exceed 1 and port flows are relatively uniform, but low pipe velocities persist at the seaward 9 ports. Sedimentation in the diffuser could therefore be a problem due to low diffuser pipe velocities. Plans for the proposed diffuser include an end bulkhead that can be removed to facilitate cleaning out the diffuser.

B. Receiving Water Description

1. Are you applying for a modification based on a discharge to the ocean or to a saline estuary [40 CFR 125.58(q)]? [40 CFR 125.59(a)]

The application is based on a discharge to a saline estuary as defined by 40 CFR 125.58(q). The existing and proposed outfalls are located in Buzzards Bay, which has a free connection to the Atlantic Ocean.

2. *Is your current discharge or modified discharge to stressed waters? If yes, what are the pollution sources contributing to the stress? [40 CFR 125.61(f)]*

The applicant considers the existing discharge to be to stressed waters, while the waters at the proposed outfall location are not considered stressed. Analysis of data presented in Section III.D supports this conclusion.

3. *Provide a description and data on the seasonal circulation pattern in the vicinity of your current and modified discharge(s). [40 CFR 125.61(a)]*

The applicant provides data on currents and circulation patterns in the vicinity of the existing and proposed discharges. Current meters were moored at mid-depth during the 1973 survey, with two deployed from mid-July to mid-August and two from mid-September to mid-October. In 1979, all four current meters were deployed from July 28 to August 13. Two of these meters were set at depths of 4.7 m (15.4 ft) and 9.3 m (30.5 ft) in the vicinity of the proposed outfall. The results of these field measurements are summarized in a table of percentile speeds, speed-direction frequency distribution plots, and progressive vector plots in the revised application. The applicant concludes that currents measured in the surveys are primarily tidally driven, and, for the outer harbor stations (near the proposed outfall), the northeast-southwest tidal excursion is of the order of 2 km (1.2 mi). The net current motion at all current stations was directed to the north, northwest, or west. Currents at the proposed discharge site were more northerly near the bottom and more westerly near the surface. Drogue studies conducted in 1979 support these conclusions. The applicant states that there is little seasonal variation of tidal current patterns, but provides no evidence to support this statement.

4. *Oceanographic conditions in the vicinity of the current and proposed modified discharge(s). Provide data on the following: [40 CFR 125.61(a)]*

- *Lowest ten percentile current speed (m/sec)*
- *Predominant current speed (m/sec) and direction (true) during the four seasons*
- *Period(s) of maximum stratification (months)*
- *Period(s) of natural upwelling events (duration and frequency, months)*
- *Density profiles during period(s) of maximum stratification*

The applicant summarizes the oceanographic conditions in the vicinity of the current and proposed discharges as follows:

	Current Discharge	Proposed Discharge
Lowest Ten Percentile Current Speed	1.6 cm/sec (0.052 ft/sec)	5 cm/sec (0.16 ft/sec)
Predominant Current Speed and Direction		
Neap Tide		
Speed:	4 cm/sec (0.13 ft/sec)	10 cm/sec (0.33 ft/sec)
Direction:	NNE/SW	NE/SW
Spring Tide		
Speed:	8 cm/sec (0.26 ft/sec)	16 cm/sec (0.52 ft/sec)
Direction:	NNE/SW	NE/SW
Period(s) of Maximum Stratification	July and August	July and August
Period(s) of Natural Upwelling Events:	None in Buzzards Bay.	

The applicant selected the lowest ten percentile current speed of 5 cm/sec (0.16 ft/sec) from Station 8, the station nearest the proposed discharge. The lowest ten percentile current speed at Station 7 (also near the proposed discharge) was 4 cm/sec (0.13 ft/sec). Furthermore, in the 1979 application, the applicant chose 3 cm/sec (0.10 ft/sec) as a conservative estimate of the lowest ten percentile current speed. This selection was based on data from all stations, including the nearshore stations where weaker currents were found. For the analyses in this review, a lowest ten percentile current speed of 4 cm/sec is assumed, as this is the lowest, and therefore most conservative, value actually observed in the vicinity of the proposed discharge.

From the data presented in Tables IB8 and IB9 of the revised application for the period July 28 to August 13, 1979, the following mean current speeds were calculated during this review:

Speed cm/sec (ft/sec)		
Station 7	Station 8	Direction-True Bearing
13.3 (0.44)	15.3 (0.50)	45° (northeast)
13.3 (0.44)	16.7 (0.55)	225° (southwest)
10.8 (0.35)	9.4 (0.31)	315° (northwest)
7.4 (0.24)	7.3 (0.24)	135° (southeast)

The measurement depth at Station 7 was 9.3 m (30.5 ft) and at Station 8 was 4.7 m (15.4 ft). The computed speeds are consistent with the predominant currents speeds given by the applicant for neap and spring tide conditions.

Data presented by the applicant support the selection of July and August as the period of maximum stratification over the water column. The applicant states that the greatest density gradient (0.345 $kg/m^3/m$) in the area occurred in December. This gradient was correctly rejected as an outlier. The next greatest average density gradients, all under 0.245 $kg/m^3/m$, were measured on July 28, 1979. These gradients are greater (and thus provide more conservative initial dilutions) than the 0.20 $kg/m^3/m$ gradient selected in the 1979 application to determine critical initial dilution. Additional temperature and salinity data presented in the revised application result in much weaker calculated density gradients. The density profiles are also approximately linear, showing no evidence of a pronounced pycnocline. Therefore, the applicant's choice of a uniform density gradient is supported by the field data. However, the applicant's selection of a critical density gradient of 0.242 $kg/m^3/m$ is subsequently shown herein to be overly conservative.

5. *Ambient water quality conditions during the period(s) of maximum stratification: at the zone of initial dilution (ZID) boundary, at other areas of potential impact, and at control stations. [40 CFR 125.61(a)(2)]*

The revised application contains receiving water quality data such as temperature, salinity, BOD_5, dissolved oxygen, suspended solids, pH, and total settleable solids for July and August (the period of maximum stratification). Also included are data on total and fecal coliform bacteria, ammonia nitrogen, nitrate nitrogen, total Kjeldahl nitrogen, chlorides, chlorophyll a, and total phosphorus. These data are summarized in Tables IB10, IB11, and IB12, and in Appendix C in the revised application. These data were collected at the existing and proposed outfall sites by the Massachusetts Department of Environmental Quality Engineering in 1980, and by the applicant in 1983.

In the vicinity of the existing discharge, July to August surface water temperatures ranged from 19.8 to 25.9° C. Temperatures generally decreased with depth, being between 19.1 and 23.9° C at the discharge depth of 9.0 m (29.5 ft). Salinity was relatively constant throughout the water column except for being somewhat lower in the upper 1.5 m (5 ft). Surface values ranged from 30.0 to 31.8 ppt, whereas near bottom salinities were between 32.1 and 34.0 ppt during this period. Surface dissolved oxygen concentrations were 6.1 to 9.6 mg/l, while near-bottom concentrations were 6.0 to 8.3 mg/l. BOD_5 concentrations near the surface ranged from 2.1 to greater than 7.2 mg/l, and near the bottom they ranged from 1.6 to 1.7 mg/l. July suspended solids concentrations were between 36 and 112 mg/l in the upper waters, and between 34 and 40 mg/l near the bottom. In late August, pH was typically 8.0 in both surface and bottom waters. Total and fecal coliform bacteria concentrations in surface waters during this period were 4,200 and 2,300 MPN/100 ml, respectively. Corresponding near-bottom concentrations are reported by the applicant to have been 40 and 170 MPN/100 ml; the fact that the total coliform bacteria concentrations were less than the fecal coliform bacteria concentrations was not explained.

At the proposed diffuser site between July and August, near-surface water temperatures ranged between 19.0 and 24.1^{o} C, decreasing with depth to between 17.9 and 21.5^{o} C near the bottom at 12 m (39.4 ft). Salinities ranged from 31.7 to 32.8 ppt near the surface and from 31.8 to 33.8 ppt at the discharge depth. Dissolved oxygen concentrations in near-surface waters were between 7.0 and 8.7 mg/l, while near-bottom concentrations ranged from 6.3 to 8.4 mg/l. BOD_5 determinations for July samples indicated surface concentrations of 1.4 to 3.4 mg/l, and near-bottom concentrations of 0.8 to 1.1 mg/l. Suspended solids concentrations at the proposed offshore site appeared to be somewhat lower than those at the existing discharge site, being 26-36 mg/l at the surface and 35-42 mg/l near the bottom in July. In late August, pH varied from 8.0 near the surface to 7.9 near the bottom. Total and fecal coliform bacteria concentrations during this period were low (0 to 3 MPN/100 ml).

The applicant states that there are no other periods when receiving water quality conditions may be more critical than during the period of maximum summer stratification. High density gradients may occur during winter when fresh water enters Buzzards Bay from storm runoff and direct precipitation, creating a highly-stratified layer near the water surface. The applicant expects dissolved oxygen levels to be high during winter; however, no supporting data are provided. Receiving water quality data for other periods of the year are not provided in either the original or revised applications.

> 6. *Provide data on steady state sediment dissolved oxygen demand and dissolved oxygen demand due to resuspension of sediments in the vicinity of your current and modified discharge(s) (mg/l/day).*

The applicant reports measured values of sediment oxygen demand of 0.624 $g/m^2/day$ at the proposed discharge site and 0.441 $g/m^2/day$ at a control site. It appears that the steady state sediment dissolved oxygen demand was incorrectly calculated, and that the correct values using the applicant's input are 0.750 $g/m^2/day$ at the proposed discharge and 0.585 $g/m^2/day$ at the control site. The steady state sediment oxygen demand is given in units of oxygen mass per unit bottom area per day, and cannot be directly converted to oxygen depletion throughout the water column.

No data on oxygen demand due to resuspension of sediments are provided in either the original or revised applications. The applicant states that oxygen demand due to resuspension of sediments was not measured.

C. *Biological Conditions*

1. *Provide a detailed description of representative biological communities (e.g., plankton, macrobenthos, demersal fish, etc.) in the vicinity of your current and modified discharge(s): within the ZID, at the ZID boundary, at other areas of potential discharge-related impact, and at reference (control) sites. Community characteristics to be described shall include (but not be limited to) species composition; abundance; dominance and diversity; spatial/temporal distribution; growth and reproduction; disease frequency; trophic structure and productivity patterns; presence of opportunistic species; bioaccumulation of toxic materials; and the occurrence of mass mortalities.*

The original (1979) New Bedford application included site-specific data on phytoplankton, zooplankton, benthic infauna, intertidal macrofauna and algae, demersal fishes and megafaunal invertebrates, and shellfish. These data were evaluated in detail by Tetra Tech (1981). The revised application includes additional data collected in August and October, 1983, which supplement those collected in 1979. For the revised application, emphasis was placed on sampling of phytoplankton, benthic infauna, and fishes, since these are the biotic groups most likely to be adversely affected by the effluent discharge.

Phytoplankton

Tetra Tech (1981) found that phytoplankton data presented in the original application revealed dramatic differences in community composition and minor differences in abundance between sampling stations located in the vicinity of the outfall and sampling stations located near the proposed outfall and in reference areas. However, it could not be determined whether these differences were associated with the discharge of sewage effluent because of numerous deficiencies in sampling design, frequency, and location. Tetra Tech (1981) concluded that "more extensive sampling would be required to determine whether these observed trends are statistically significant and whether they occur at other times throughout the year." Consequently, additional sampling of phytoplankton was conducted during two periods in 1983.

Duplicate 250-ml samples for analysis of phytoplankton abundance and species composition were collected with a Van Dorn bottle at 10 stations during the weeks of August 29 and October 3, 1983. An additional 250-ml sample for chlorophyll *a* was also collected at each station. The applicant indicates that all samples were from subsurface depths, but does not specify the actual depth. Stations where phytoplankton sampling was conducted included (Figure 2):

- Stations 3 and 2 [11-12 m (36-39 ft) north and south of the existing discharge]
- Stations 4 and 9 [0.5 km (0.3 mi) north and southwest of the existing discharge]
- Stations 6 and 10 [1.0 km (0.6 mi) north and southwest of the existing discharge]
- Station 7 [2.0 km (3.2 mi) north of the existing discharge]

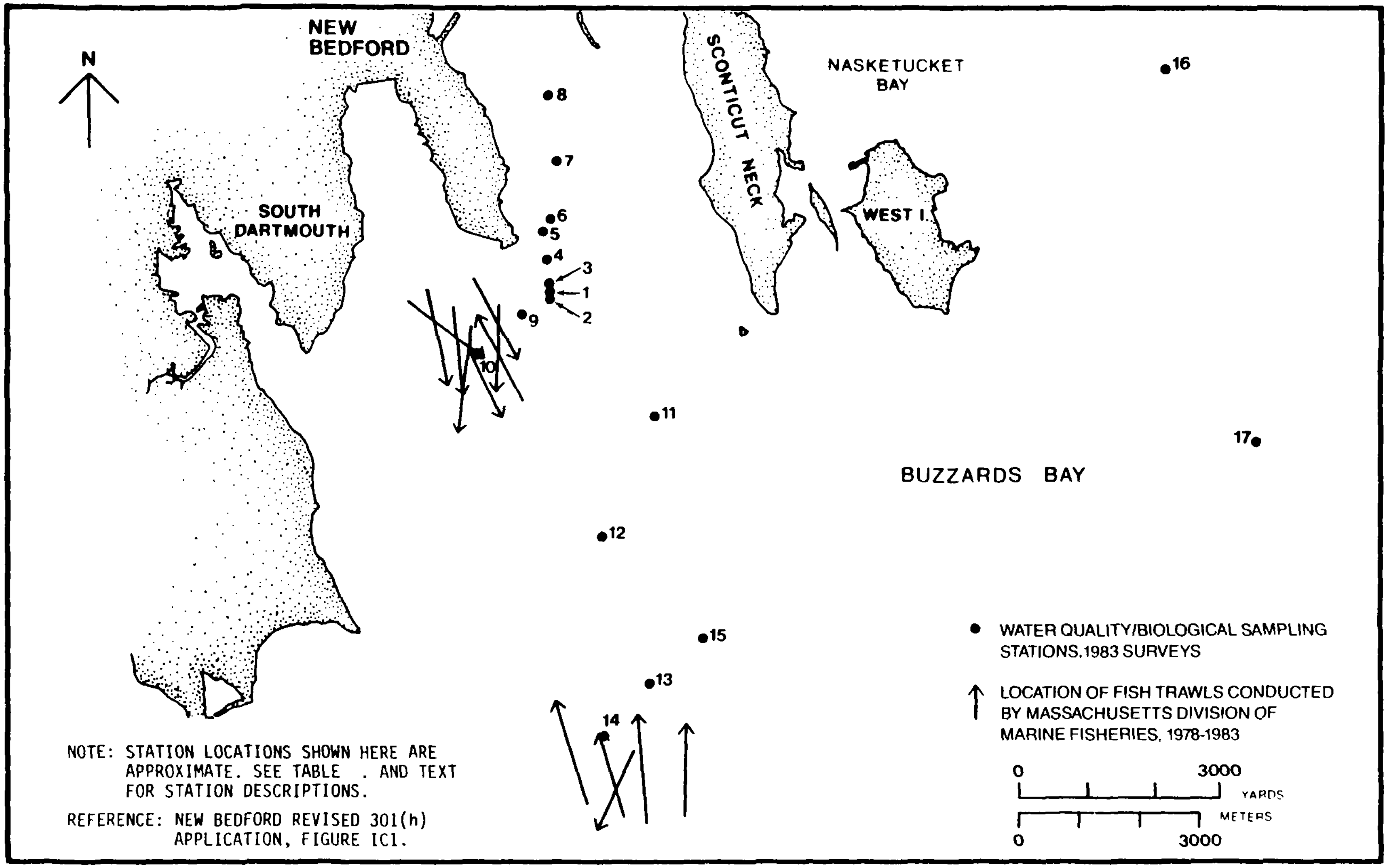


Figure 2. Location of water quality and biological sampling stations (1983), and of Massachusetts Division of Marine Fisheries trawl stations (1978-1983).

- Station 13 - site of proposed discharge
- Station 16 - nearshore reference site off Mattapoisett Neck
- Station 17 - offshore reference site in Buzzards Bay.

Station locations were appropriate for characterization of phytoplankton in the vicinity of the existing and proposed discharge sites, as well as in reference areas.

Phytoplankton samples were preserved with Lugol's iodine solution. Identification to the lowest possible taxon and enumeration of phytoplankton were performed according to the Utermohl technique. Pigment samples were filtered onto glass-fiber filters, which were then frozen and returned to the laboratory for extraction and fluorimetric determination of chlorophyll a and phaeopigments. Although not specified, the procedure used in pigment analysis was apparently that described by Strickland and Parsons (1972). In general, these methods are appropriate for quantitative sampling of phytoplankton (Stofan and Grant 1978). However, it should be noted that pigment samples that have been frozen usually give lower results than do those that have not been frozen.

Data from replicate determinations of phytoplankton abundance and species composition were averaged, and the average values were used in a variety of statistical procedures. Both numerical and nodal analyses were performed on transformed data (log x+1) utilizing the Bray-Curtis similarity index (Sneath and Sokal 1973; Clifford and Stephenson 1975; Boesch 1977). The Shannon-Wiener index of diversity and its evenness component were also calculated (Shannon and Weaver 1949).

Sixty phytoplankton taxa were identified in the 40 samples collected during the two sampling periods. In terms of numerical abundance, ten species accounted for 96.4 percent of the phytoplankton (see Table IC8 in the application). Diatoms and blue-green algae together accounted for about 90 percent of the phytoplankton, with the remaining 10 percent represented by various dinoflagellates, euglenoids, and unidentified unicellular algae. Frequency of occurrence was high for the ten most abundant species, ranging from 35 percent for the euglenoid *Eutreptia* sp., to 100 percent for two diatom species (*Skeletonema costatum* and *Chaetoceros* sp.), unidentified dinoflagellates, and an unidentified flagellate.

August collections were dominated by diatoms, principally *Skeletonema costatum*. Abundance of diatoms ranged from 3,700-7,400 cells/ml (79-94 percent of the phytoplankton) at stations in the vicinity of the existing discharge, and from 800-1,300 cells/ml (47-78 percent of the phytoplankton) at the proposed discharge and reference stations. Relative abundance of *S. costatum* ranged from 83-90 percent of the diatom population at stations in the vicinity of the existing discharge and from 15-55 percent of the diatom population in the vicinity of the proposed discharge and reference stations.

October collections were dominated by blue-green algae. Abundance of blue-green algae ranged from 33-132,695 cells/ml (0.7-94 percent of the phytoplankton) at stations in the vicinity of the existing discharge, and from 203-5,923 cells/ml (7.1-70 percent of the phytoplankton) at the proposed discharge and reference stations. It should be noted that blue-green algae represented over 50 percent of the phytoplankton at seven of the eight stations in the nearshore area, including the nearshore reference station.

There were no obvious spatial patterns in abundance (Table IC3 of the revised application) or species diversity (Table IC5 of the revised application) in the August collections of phytoplankton. Among the October collections, phytoplankton abundance was high and species diversity was low at Station 6, which is 1.0 km (0.6 mi) north of the existing discharge, and at Station 10, which is 1.0 km (0.6 mi) southwest of the existing discharge. Blue-green algae were exceedingly abundant at these two stations (approximately 133,000 cells/ml at Station 6 and 19,000 cells/ml at Station 9), thereby accounting for low evenness and diversity indexes.

The concentration of chlorophyll _a_ is an index of phytoplankton biomass in sea water. However, chlorophyll _a_ in dead algal cells rapidly degrades to other pigments, which are measured collectively as "phaeopigments" (Strickland and Parsons 1972). Both pigments are measured because phaeopigments interfere in the analysis of chlorophyll _a_. The difference between concentrations of chlorophyll _a_ and phaeopigments provides a corrected index of the biomass of living phytoplankton. However, it is uncertain whether or not this correction was applied to the chlorophyll _a_ data, since the concentrations of both chlorophyll _a_ and phaeopigments are presented independently by the applicant (see Figure IC2 in the revised application).

Assuming that the data are corrected for phaeopigments, then chlorophyll _a_, and presumably phytoplankton biomass, was greatest within 1.0 km (0.6 mi) of the existing discharge site during both collection periods. However, the range of concentrations of chlorophyll _a_ (0.3-3.0 ug/l) in the New Bedford area falls within that of other temperate bays and estuaries (Boynton et al., 1982). The extent to which freezing of the filters prior to analysis decreased the chlorophyll _a_ values and thereby biased comparisons with other data is unknown. The data for the August collections indicate that the biomass of living cells exceeded that of non-living cells at Stations 2 and 3, and that the greatest living biomass occurred near the existing discharge. The living and non-living fractions at each of the remaining stations were roughly equal. The October collections indicate that living biomass was greatest at Station 6, and that the ratio of living to non-living biomass increased along a north-south gradient between Station 7, which is nearshore, and Station 13, which is offshore.

Numerical classification based on normal cluster analysis reveals distinct temporal and spatial groups. The August and October collections clustered separately from one another (see Figure IC3 in the revised application). The pattern of clustering was largely the same for each month's collections. Stations that grouped together in both months were the ZID boundary stations (2 and 3), and nearfield stations inshore of the discharge (4, 6, and 7). Farfield stations south of the discharge (9 and 10) were grouped separately from the reference stations (16 and 17) and the proposed discharge site (Station 13) in August, but all these stations were grouped together in October. Importantly, the nearshore reference station was not classified with the ZID boundary stations.

Nodal analysis showed that stations close to the existing discharge (2 and 3) were characterized by various filamentous and colonial blue-green algae, euglenoids, flagellates, and several species of diatoms (Species Groups A, B, and F), whereas reference stations and the station at the site of the proposed discharge were characterized by the absence or low percent constancy of these groups. Species Group D contained most of the abundant taxa, and was found throughout the study area. This group contained *Skeletonema costatum*, which was the dominant taxa in the August collections, and an unidentified blue-green alga, which was the dominant taxon in the October collections.

The applicant compares phytoplankton abundance and diversity in the area of the New Bedford outfall with that in Narragansett Bay (Smayda 1957; also see Smayda 1973) and Block Island Sound (Staker and Bruno 1978). *Skeletonema costatum* was the dominant species in all three areas. *Chaetoceros* sp. and microflagellates were also abundant in Narragansett Bay and New Bedford waters. However, species of blue-green algae that were dominant in the New Bedford area were not prevalent in either Narragansett Bay or Block Island Sound.

Benthic Infauna

Based on benthic infauna data submitted in the original application, Tetra Tech (1981) concluded that the low species richness, species diversity, and faunal density in the vicinity of the existing discharge, and the dominance of these communities by opportunistic polychaete species, were indicative of organic enrichment of the benthic substrate attributable to the effluent discharge. However, due to poor spatial coverage of the previous sampling program, it was not possible to determine the areal extent of these community perturbations. Consequently, additional sampling of benthic infauna, including a larger number of stations in proximity to the existing discharge, was conducted in 1983 in support of the revised application.

The applicant presents the results of a benthic survey conducted near New Bedford's existing and proposed discharge sites and at control areas during the week of August 29, 1983. The main objective of this study was to characterize benthic infaunal communities of outer New Bedford Harbor and Buzzards Bay in terms of species composition, species richness, diversity, evenness, species abundances, total infaunal abundance, constancy and fidelity of species groups to station groups, and other aspects of community structure. The applicant also presents the results of sediment analyses, including grain-size composition and total volatile solids content. These parameters are herein considered appropriate for describing coastal communities of benthic macroinvertebrates and their habitats. A complete data set [consisting of the mean numbers of individuals of each species per 0.1 m^2 (1.1 ft^2) at each station] and detailed analyses of the data are provided in Section II.C.1 of the revised application. Data are not given for individual replicates, however. Since benthic infauna were sampled mainly during summer in both the 1979 survey reported in the original application (which was evaluated by Tetra Tech 1981) and in the August, 1983, survey, the applicant has not provided adequate data on seasonal variation of benthic infaunal communities.

Benthic infaunal samples were collected by the applicant at 12 stations (Figure 2):

- Station 1 is located within the ZID of the existing outfall
- Stations 2 and 3 are located just outside the existing ZID
- Stations 4 and 9 are located at 0.5 km (0.3 ft) north and southwest of the existing discharge, respectively
- Stations 6 and 10 are located at 1.0 km (0.6 mi) north and southwest of the existing discharge, respectively
- Station 13 is located within the ZID of the proposed outfall

- Stations 14 and 15 are located 1.0 km (0.6 mi) southwest and northeast of the proposed discharge site, respectively

- Stations 16 and 17, the control sites for the existing and proposed discharge areas, respectively, are located off Mattapoisett Neck in Buzzards Bay.

The sampling sites chosen by the applicant are well-suited for assessing potential impacts of the existing and proposed discharges. Adequate spatial coverage was provided at the existing and proposed outfall sites. Stations 3, 4, and 6 are located "downstream" of the existing discharge along the approximate axis of predominant current flow during flood tide; Stations 2, 9, and 10 are located "downstream" of the existing discharge along the approximate axis of predominant current flow during ebb tide. These stations, along with Station 1 within the ZID, allow an analysis of gradients in benthic infaunal parameters in relation to distance from the discharge. The control sites, Stations 16 and 17, are each located over 10 km (6.2 mi) from the existing and proposed discharge sites. Since they appear to be beyond the potential influence of the discharges and beyond the immediate influence of the New Bedford urban area, they are herein considered suitable reference sites. Water depth and sediment characteristics at each control site are also generally similar to those at the corresponding discharge area (Table 5). Water depths at all sampling sites are within a narrow range [7.3-13.8 m (24-45 ft)].

The revised New Bedford application is for a discharge to stressed waters. Since Stations 2, 3, 4, 6, 9, and 10 are within an area potentially influenced by the applicant's existing discharge, none of these stations can serve as a stressed control site. As discussed later in this section, the benthic infaunal assemblages at Stations 4, 6, 9, and 10 are similar to each other, but they differ from infaunal communities at stations closer to the discharge and at the control areas. Therefore, a stressed control site was not sampled during the benthic infaunal survey. This is not necessarily a serious deficiency, because the applicant bases the "stressed waters" classification of the existing discharge site on contamination by coliform

TABLE 5. WATER DEPTHS AND SEDIMENT CHARACTERISTICS AT BENTHIC INFAUNAL SAMPLING STATIONS

Station	Depth, m (ft)	Percent Silt-Clay	Percent Total Volatile Solids[a]
1	12.0 (39.4)	11.7	3.6
2	10.0 (32.8)	26.9	17.3
3	8.0 (26.2)	9.3	4.2
4	7.3 (24.0)	35.3	4.2
6	7.6 (24.9)	72.0	9.1
9	9.1 (29.9)	77.3	9.5
10	7.6 (24.9)	4.7	1.0
13	13.7 (44.9)	63.1	4.8
14	13.8 (45.3)	83.0	6.9
15	13.0 (42.7)	14.6	1.6
16	8.0 (26.2)	12.4	1.4
17	13.7 (44.9)	81.2	6.8

[a] Reported as percent organic carbon by the applicant.

Source: New Bedford revised 301(h) application, Tables IC2 and IC9.

bacteria and PCBs, and not on alteration of infaunal community structure (see below, Section III.D.8).

Sampling stations were positioned during the applicant's survey by using a Motorola "mini-ranger" system. The outfall station was located by visually sighting the discharge plume, then using a fathometer to find the end of the outfall. Mini-ranger coordinates for all sampling stations are provided in Table IC2 of the revised application. The methods used by the applicant for locating sampling stations are adequate.

At each sampling site, five replicate 0.1-m^2 (1.1-ft^2) van Veen grab samples were collected. Infaunal samples were washed on a 0.5-mm (0.02-in) sieve in the field, and preserved in a 10 percent solution of buffered formalin. Sediment for grain size analysis was sampled using a 2.3-cm (0.9-in) diameter core. Presumably, each sediment grain-size sample was taken as a subsample of a van Veen grab sample, but this is not explicitly stated in the revised application. Information on sample collection methods for sediments analyzed for total volatile solids is not given.

As far as they are described, the sample collection methods used by the applicant are adequate. The use of a 0.5-mm (0.02-in) mesh sieve should ensure collection of samples that are adequate for most quantitative analyses. Since data are not provided for individual replicate samples, the adequacy of five 0.1-m^2 (1.1-ft^2) samples for characterizing species composition and abundance cannot be evaluated quantitatively in this review. However, other studies of benthic infauna in coastal and estuarine areas have shown that five replicate 0.1-m^2 (1.1-ft^2) samples are generally adequate to assess species composition and total numerical abundance (Lie 1968; Holme and McIntyre 1971; Swartz 1978). Also, standard deviations reported by the applicant indicate an acceptable level of precision in estimates of mean species richness per station and mean number of individuals per sample.

In the laboratory, infaunal samples were stained with Rose Bengal and resieved into three fractions [25 mm (1 in), 1 mm (0.04 in), and 0.5 mm (0.02 in)]. After sorting of the samples, specimens were identified to species or lowest possible taxon using a verified reference collection maintained by Normandeau Associates. Ten percent of the sorted and identified samples were reprocessed as a quality control measure. Although these methods are acceptable, other quality control/quality assurance procedures are not described.

Taxonomic personnel, their qualifications, and reference works used to identify species are not described in the revised application. Nevertheless, inspection of Table IC10 of the revised application reveals that a large number of species were identified and that only a few of the organisms classified into higher taxonomic categories formed a substantial component of the community in collections from at least one station (e.g., Tellinidae at Station 6, Oligochaeta at Station 9, and Caulleriella sp. B, Cirratulidae, and Anomia sp. at Station 10. The results in Table IC10 suggest that the taxonomic identifications were acceptable for characterization of species composition, quantitative analysis of community structure, and impact assessment.

Grain size analysis of sediment samples was conducted according to generally-accepted procedures (Folk 1974), using standard geological sieves with mesh sizes at half-phi intervals. Apparently, pipette analysis of the silt-clay fraction was conducted, although the applicant reports only the total percentage of silt plus clay. Total volatile solids content was determined by loss on ignition, but further description of the method is not provided. Note that the applicant refers to total volatile solids content as "organic carbon content."

The applicant provides a detailed statistical analysis of the 1983 benthic infaunal data. Species richness and total abundance data were examined using analysis of variance (ANOVA) and the Student-Newman-Keuls multiple comparison test to test for differences among stations (Sokal and Rohlf 1969; Green 1979). Species richness data were transformed ($\log_{10} x$) to eliminate heterogeneity of the variances among stations. In addition to calculation of community indices (i.e., Shannon-Wiener diversity and Pielou's evenness) for each station, community structure was analyzed using numerical classification and nodal analysis (cf. Boesch 1977). Both normal and inverse classification were performed using the Bray-Curtis similarity index and the group average clustering strategy. All species abundance data were transformed ($\log_{10}$ x+1), and replicate data were averaged before cluster analysis was performed. Constancy, fidelity, and within-group means were calculated for each species group at each station.

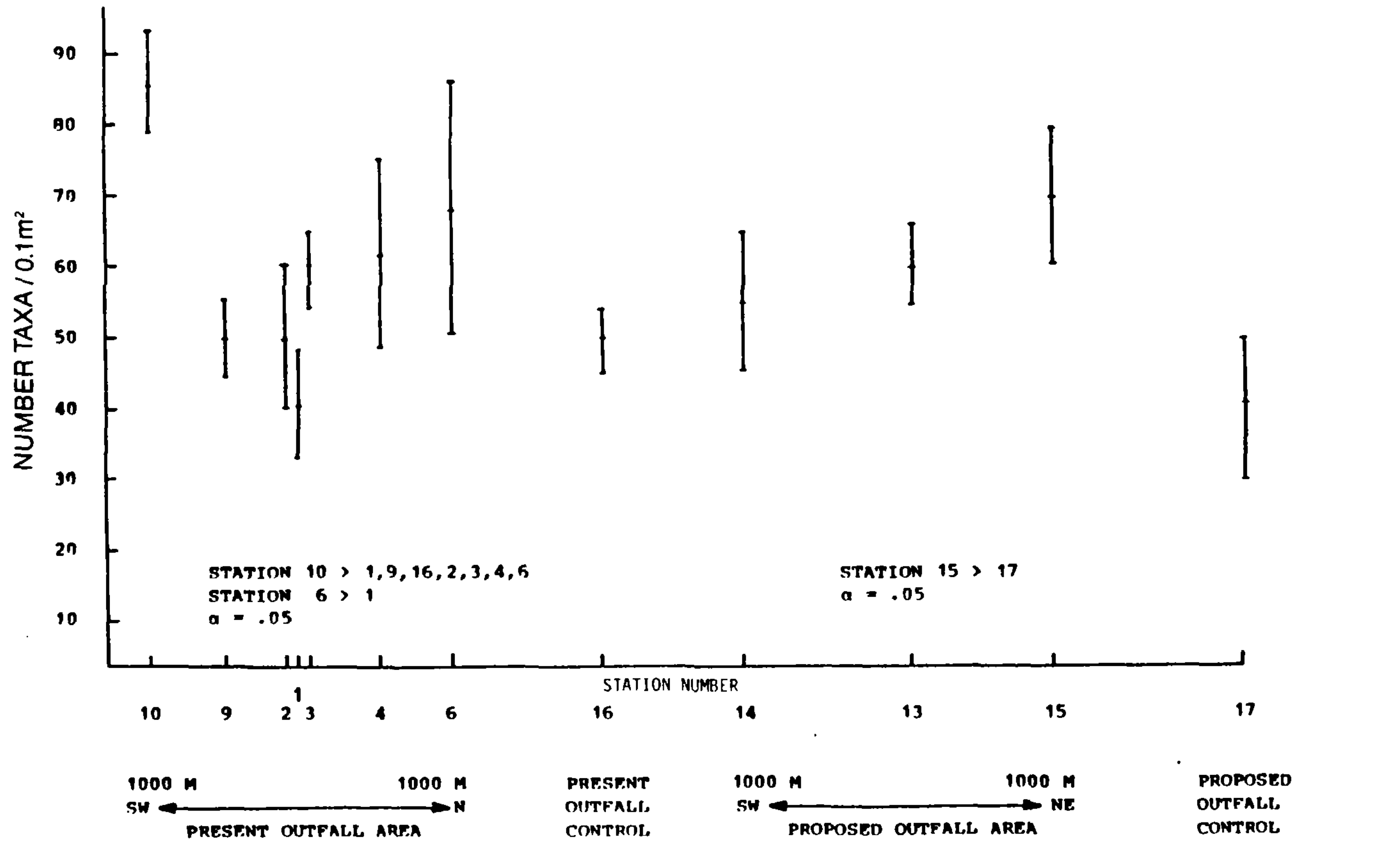
The statistical techniques used by the applicant generally represent acceptable "state-of-the-art" procedures for analyzing benthic infaunal data (cf. Sokal and Rohlf 1969; Boesch 1977; Green 1979). Some rare species were excluded from the classification analysis (e.g., comparison of Table IC10 and Figure IC9 of the revised application), but the criterion for elimination of species is not described. As discussed by Tetra Tech (1981), use of improper criteria could bias the result by exclusion of species that are rare at most stations (e.g., away from the existing discharge) but abundant at one or two stations (e.g., near the existing discharge). In some cases, the combination of removal of rare species, $\log_{10}$ (x+1) transformation of the data, and use of the Bray-Curtis similarity index may obscure between-site affinities and differences (Tetra Tech 1981). However, over 100 taxa were included in the classification analysis, which should have provided an accurate representation of community structure and between-site relationships.

In general, the applicant presents an accurate, comprehensive analysis of the benthic infaunal data. The following sections summarize the results presented by the applicant and additional analyses conducted as part of this review.

Data on sediment grain size and total volatile solids content are provided in Table 5 above and in Table IC9 and Figure IC5 of the revised application. The applicant applied Sanders' percent similarity index (Boesch 1977) to the grain size data and derived several station groups. Stations 6, 9, 13, 14, and 17 formed one group with very high similarities between all station pairs. This group was characterized by large amounts of silt-clay (63.1-83.0 percent) and moderate total volatile solids content (4.8-9.5 percent). A second group comprising Stations 1, 3, 10, 15, and 16 had generally lower similarities between station pairs, and was characterized by lesser amounts of silt-clay (4.7-14.6 percent), higher sand content (quantity unspecified), and relatively low total volatile solids content (1.0-4.2 percent). Finally, Stations 2 and 4 grouped together based on their high percentages of fine sands and moderate amounts of silt-clay. Sediments from Station 2 at the ZID boundary had the highest total volatile solids content of all sites, while those at Station 4 contained relatively little organic matter. Conventional sediment characteristics within the ZID were within the range of those observed at other stations (Table 5). Sediment grain size composition and total volatile solids content were not related to distance from the existing discharge. Data on concentrations of trace metals and PCBs in sediments are discussed in Section III.D.4 below.

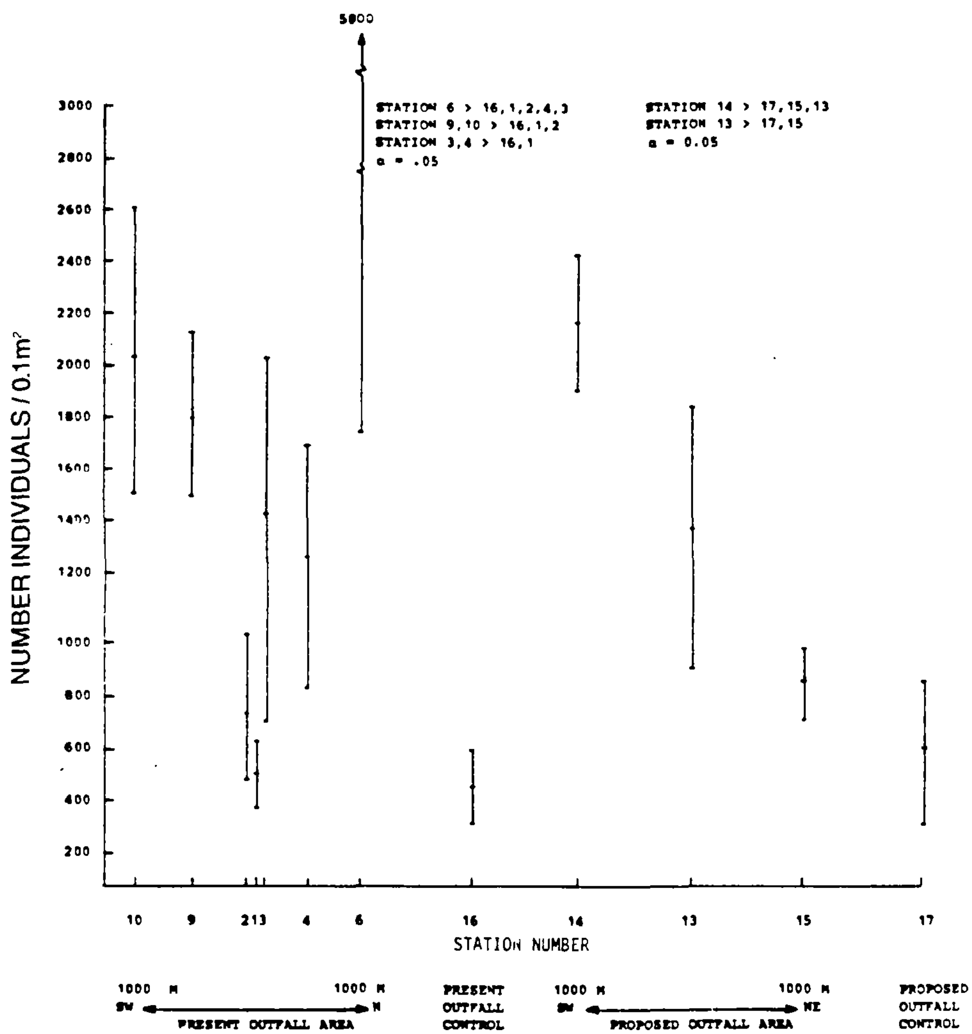
Mean species richness and total infaunal abundance generally increased with distance from the existing discharge (Figures 3 and 4). For the analysis of infaunal community parameters, the applicant used ANOVA to test for differences among stations within two station groups: 1) stations near the present discharge site (Stations 1, 2, 3, 4, 6, 9, and 10) and the control (Station 16), and 2) stations near the proposed discharge site (Stations 13, 14, and 15) and the control (Station 17). When ANOVA indicated significant differences among stations, the Student-Newman-Keuls test was used to determine the locations of these differences. The mean number of species per sample was significantly higher at Station 10 than at Stations 1, 2, 3, 4, 6, 9, and 16. Station 6 also exhibited a significantly higher species richness than did Station 1 (within-ZID), which showed the lowest number of taxa per sample. Species richness at the control site was somewhat higher than at the within-ZID station, but the difference was not statistically significant. The mean total infaunal abundance exhibited a pattern similar to that of species richness, with increasing numbers of organisms away from the discharge (Figure 4). Again, the difference between the control site and the station within the existing ZID was not statistically significant.

The total number of species per station repeated the pattern discussed above for species richness per replicate sample, but diversity (H') and evenness (J') were not clearly related to distance from the existing discharge (Table IC12 of the revised application). The total number of species collected within the existing ZID was 96, while values for all other sites ranged



REFERENCE: NEW BEDFORD REVISED 301(h) APPLICATION, FIGURE IC6

Figure 3. Mean number of taxa per replicate 0.1-m^2 (1.1-ft^2) sample (and standard deviation) for the 1983 benthic infaunal survey.



REFERENCE: NEW BEDFORD REVISED 301(h) APPLICATION, FIGURE IC7

Figure 4. Mean total infaunal abundance per replicate 0.1-m^2 (1.1-ft^2) sample (and standard deviation) for the 1983 benthic infaunal survey.

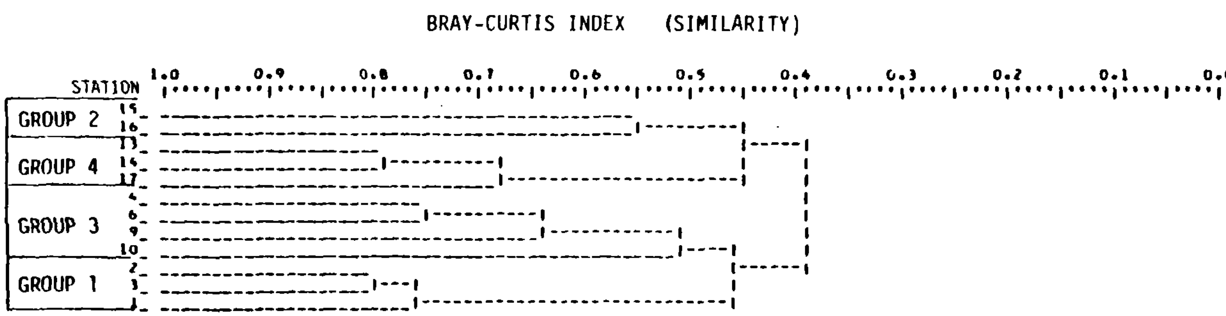
from 83 (Station 17) to 159 (Station 10). Diversity ranged from 2.106 (Station 14) to 4.835 (Station 16), with a value of 3.373 within the existing ZID. Low diversity and evenness at Station 14 near the proposed discharge site were related to a high density of the bivalve Nucula proxima at that site.

Near the proposed discharge site, mean species richness per replicate sample was similar among Stations 13, 14, and 15. Species richness was significantly higher at Station 15 than at Station 17. Mean total infaunal abundance was significantly higher at Station 14 than at Stations 13, 15, and 17, while abundance was significantly greater at Station 13 than at Stations 15 and 17. The applicant offers no explanation for patterns in species richness and infaunal abundance at stations near the proposed discharge site and its control. Differences in infaunal parameters among these stations may be related to variation in sediment characteristics or other natural habitat factors. For example, species richness in sandy habitats appeared to be higher than in finer sediments (Figure 3, Table 5).

Cluster analyses performed by the applicant revealed four distinct station groups (Figure 5):

- Group 1 included stations within and just beyond the existing ZID (Stations 1, 2, and 3)
- Group 2 consisted of Station 15 near the proposed discharge and Station 16, the control for the existing discharge
- Group 3 included all farfield stations in the existing discharge area (Stations 4, 6, 9, and 10)
- Group 4 included Stations 13 and 14 near the proposed discharge and Station 17, the control for the proposed discharge.

Station Groups 1 and 3 were more similar to one another than to Station Groups 2 and 4. Thus, spatial patterns revealed by the classification



REFERENCE: NEW BEDFORD REVISED 301(h) APPLICATION, FIGURE IC8

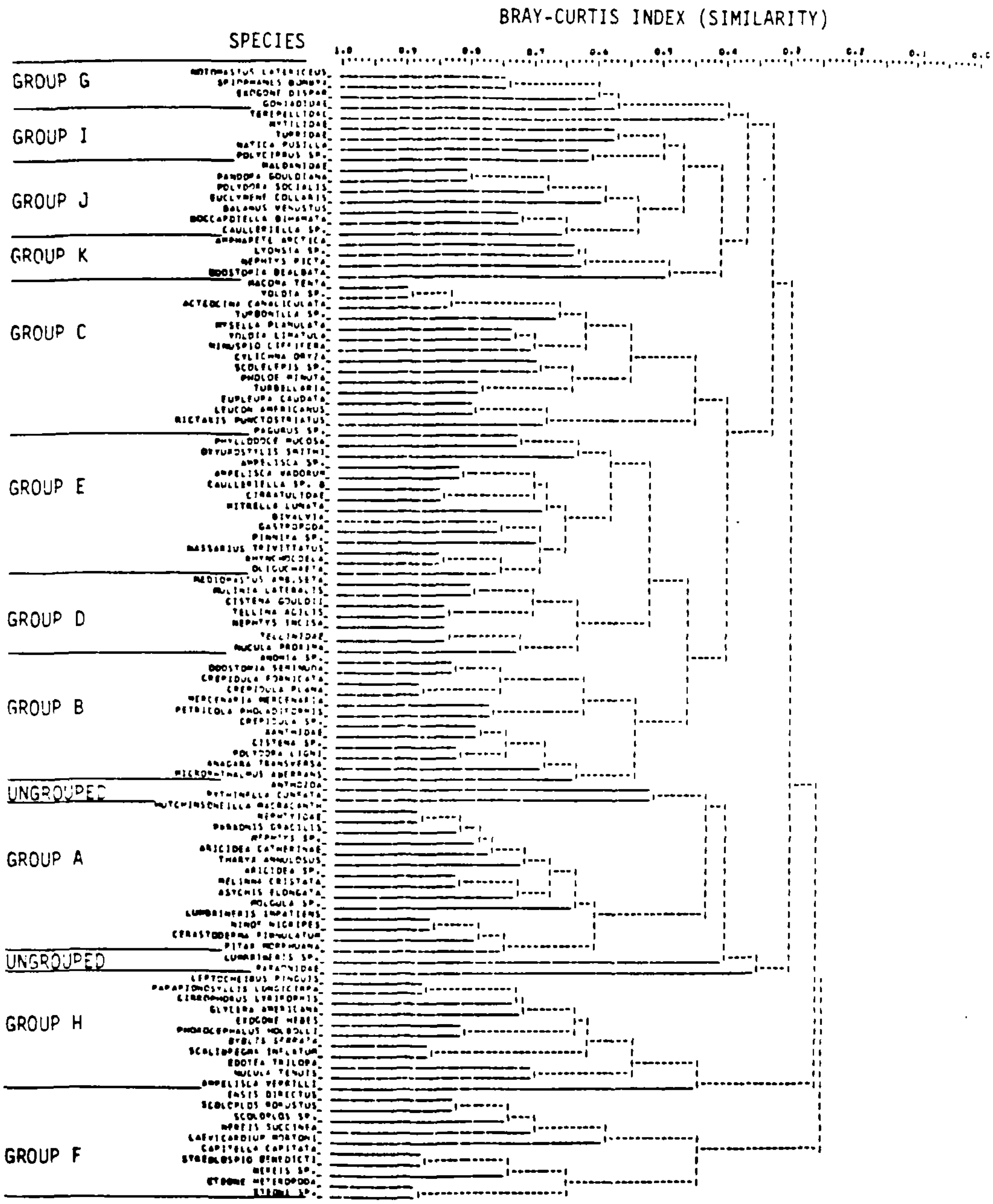
Figure 5. Normal classification analysis of 1983 benthic infaunal data.

groupings suggest that the existing discharge is having a major impact on benthic infaunal communities.

According to the applicant, eleven groups of species were delineated by the inverse classification analysis (Figure 6). Note that a minor inconsistency occurs in the clustering criteria used by the applicant. Anthozoa and Pythinella cuneata were considered ungrouped, since they clustered with Group A at a relatively low similarity level of about 0.42. However, Terebellidae was considered a member of Group G, even though this taxon joined the group at a similarity of 0.40. The applicant should have listed Terebellidae as an "ungrouped" taxon. Since terebellids were rare, this minor inconsistency in the applicant's cluster analysis would not be expected to alter substantially subsequent analysis and interpretation of the data. The remainder of the species groups distinguished by the applicant were defined by group similarities ranging from about 0.45 to about 0.63, indicating that a reasonable group-clustering approach was used.

The nodal analysis conducted by the applicant indicated that constancy values were generally high, but fidelity values were usually low (Table IC13 of the revised application). These results suggest that although species within a group occurred together frequently, a given species group was not greatly restricted to one station group. Species Groups D and E were ubiquitous, with Group D being numerically dominant overall. Species Group D is characterized by common inhabitants of estuaries along the Atlantic coast (e.g., Mediomastus ambiseta, Mulinia lateralis, and Tellina agilis). In addition, Nucula proxima and Nephtys incisa, the major faunal components of soft-bottom habitats in Buzzards Bay (Sanders 1958), are members of Group D (Figure 6). Station Group 4, which included the deepwater sites with high silt-clay content in the sediments, had a particularly high density of Nucula proxima.

The distribution of species groups among station groups is summarized by the applicant based on within-group mean values (analogous to constancy) presented in Table IC13 of the revised application. Station Group 1, including stations within and immediately beyond the existing ZID, is characterized by Species Groups D, E, and F. Although the ubiquitous species in Groups



REFERENCE: NEW BEDFORD REVISED 301(h) APPLICATION, FIGURE IC9

Figure 6. Inverse classification analysis of 1983 benthic infaunal data.

D and E were better represented at other stations, Group F was important only in the immediate vicinity of the existing discharge. As noted by the applicant, Group F is dominated by the opportunistic species Capitella capitata, Streblospio benedicti, and Nereis succinea. As shown later in this review, opportunistic species indicative of organic enrichment occur in high abundance in the study area only near the existing discharge.

Station Group 3 (farfield Stations 4, 6, 9, and 10 in the vicinity of the existing discharge) is characterized by Species Groups B, C, D, and E. Group D was particularly well represented in this station group because of high abundances of the polychaete Mediomastus ambiseta and the bivalves Nucula proxima and Mulinia lateralis at Stations 4, 6, and 9. Station 10 was somewhat different from the other stations in this group. The amphipod Ampelisca vadorum, the cumacean Oxyurostylis smithi, cirratulid polychaetes, and the gastropod Mitrella lunata of Group E were best represented at Station 10, along with Group B slipper shells (Crepidula plana and C. fornicata) and the bivalve Tellina agilis of Group D.

Species Groups A, D, E, G, and H are characteristic of Station Group 2 (Stations 15 and 16). Species Groups G and H, which are poorly represented at Station Group 1 near the existing discharge, are best represented in Station Group 2. Group H includes several pollution-sensitive species, including the amphipods Ampelisca verrilli, Phoxocephalus holbolli, and Leptocheirus pinguis. However, the abundances of these pollution-sensitive forms are low enough throughout the study area to preclude definitive conclusions about impacts of the existing New Bedford discharge. The applicant indicates that the dominant species in Groups E, G, and H are associated with sandy sediments, which occur at both stations in Station Group 2 as well as at Stations 1 and 3 near the existing discharge.

The deepwater stations in Station Group 4 were characterized by high densities of Nucula proxima and other species in Species Group D, reflecting a high silt-clay content of the substrate. The polychaetes Ninoe nigripes and Lumbrineris impatiens and the bivalve Pitar morrhuana of Species Group A were also important components of the communities of Station Group 4.

In addition to classification and nodal analyses, the applicant presents data on average abundances of each dominant species within each station group (Table 6). These data reveal the same general patterns of species distributions as were revealed in the nodal analysis. For example, Capitella capitata, Mediomastus ambiseta, Streblospio benedicti, Cistena gouldii, and Mulinia lateralis were dominant near the existing discharge. Most of these species are considered opportunists, which dominate in early successional stages of naturally-disturbed habitats, or in organically-enriched environments. Station Group 4, which includes the control station for the existing discharge, was dominated by taxa common to soft sediments of Buzzards Bay (e.g., Nucula proxima, Pitar morrhuana, Nephtys incisa, and Tellinidae).

As part of this evaluation, the spatial distributions of opportunistic species indicative of organic enrichment (cf. Pearson and Rosenberg 1978) were examined in detail, based on abundance data in Tables IC10 and IC11 of the revised application. The results of this analysis show that 23 opportunistic taxa were found in the samples (Table 7). Fourteen of these 23 taxa were found only near the existing discharge (Stations 1-4, 6, 9, and 10) or at higher abundances near the existing discharge than away from it (Stations 13-17). Five opportunistic species were found primarily at sites away from the existing discharge, but these species were generally rare. Several species, including the common polychaete Lumbrineris impatiens, were found at sites both near and distant from the existing discharge, thereby exhibiting no clear spatial relationship which might be suggestive of discharge-related impacts.

Effects of the existing New Bedford discharge are clearly evident in the spatial distributions of those opportunistic species associated with the highest levels of organic enrichment (Figure 7). The abundances of Capitella capitata, Streblospio benedicti, Polydora ligni, Mediomastus ambiseta, and Macoma tenta are greatly enhanced near the existing discharge. Although the effects of the discharge appear to extend at least 1.0 km (0.6 mi) to the north and at least 0.5 km (0.3 mi) to the southwest from the discharge site, the composition of the dominant opportunistic fauna shifts in accordance with current conceptual models of disturbance by organic

TABLE 6. MEAN ABUNDANCES (No./0.1 m^2) OF DOMINANT BENTHIC INFAUNAL SPECIES WITHIN STATION GROUPS

Dominant Taxa	Station Group[a] 1	2	3	4
Capitella capitata	265.9	0.6	0.2	0.3
Mediomastus ambiseta	196.7	30.7	251.2	3.0
Streblospio benedicti	99.7	0.2	0.5	0.1
Cistena gouldii	45.4	2.4	10.8	0.6
Mulinia lateralis	31.0	0.02	373.5	2.7
Ampelisca verrilli	1.1	90.0	12.3	0.1
Cerastoderma pinnulatum	0.6	61.7	1.7	17.8
Ninoe nigripes	0.2	45.2	1.0	30.7
Byblis serrata	0.0	41.3	0.5	0.0
Nucula proxima	1.3	3.4	290.5	779.5
Odostomia seminuda	0.3	0.3	115.8	0.2
Crepidula plana	9.2	0.3	90.4	0.1
Crepidula fornicata	4.7	0.2	84.8	0.1
Cirratulidae	1.9	14.0	69.1	6.2
Pitar morrhuana	0.2	8.4	9.3	56.7
Tellinidae	22.7	5.5	64.9	58.1
Nephtys incisa	5.9	6.6	47.1	55.7
Lumbrineris impatiens	0.1	11.4	0.7	44.9

[a] Station Group 1 = Sta 1,2,3
2 = Sta 15,16
3 = Sta 4,6,9,10
4 = Sta 13,14,17.

Source: New Bedford revised 301(h) application, Table IC14.

TABLE 7. GENERAL DISTRIBUTION OF OPPORTUNISTIC SPECIES IN RELATION TO THE EXISTING NEW BEDFORD DISCHARGE

Location	Species
Near existing discharge[a]	*Capitella capitata (P)
	*Streblospio benedicti (P)
	*Mediomastus ambiseta (P)
	**Polydora ligni (P)
	Macoma tenta (B)
	Oligochaeta
	**Eumidia sanguinea (P)
	**Scoloplos robustus (P)
	**Heteromastus filiformis (P)
	**Eteone longa (P)
	**Nereis diversicolor (P)
	**Mya arenaria (B)
	**Corophium acutum (A)
	**Corophium tuberculatum (A)
Away from existing discharge[b]	**Lumbrineris fragilis (P)
	Protodorvillea gaspeensis (P)
	Schistomeringus caeca (P)
	**Polydora quadralobata (P)
	**Prinospio heterobranchia (P)
No pattern[c]	Nephtys incisa (P)
	*Lumbrineris impatiens (P)
	Eteone heteropoda (P)
	Corophium acherusicum (A)

(P) = Polychaete (A) = Amphipod (B) = Bivalve

*Dominant species.
**Species was found only in area indicated.

[a] Within 1.0 km (0.6 mi) of existing discharge: Stations 1, 2, 3, 4, 6, 9, and/or 10.

[b] More than 6 km (3.7 mi) from existing discharge: Stations 13, 14, 15, 16, and/or 17.

[c] No apparent relationship exists between species abundance and distance from the existing discharge. Distribution of these species is probably more closely related to sediment conditions or other natural environmental factors.

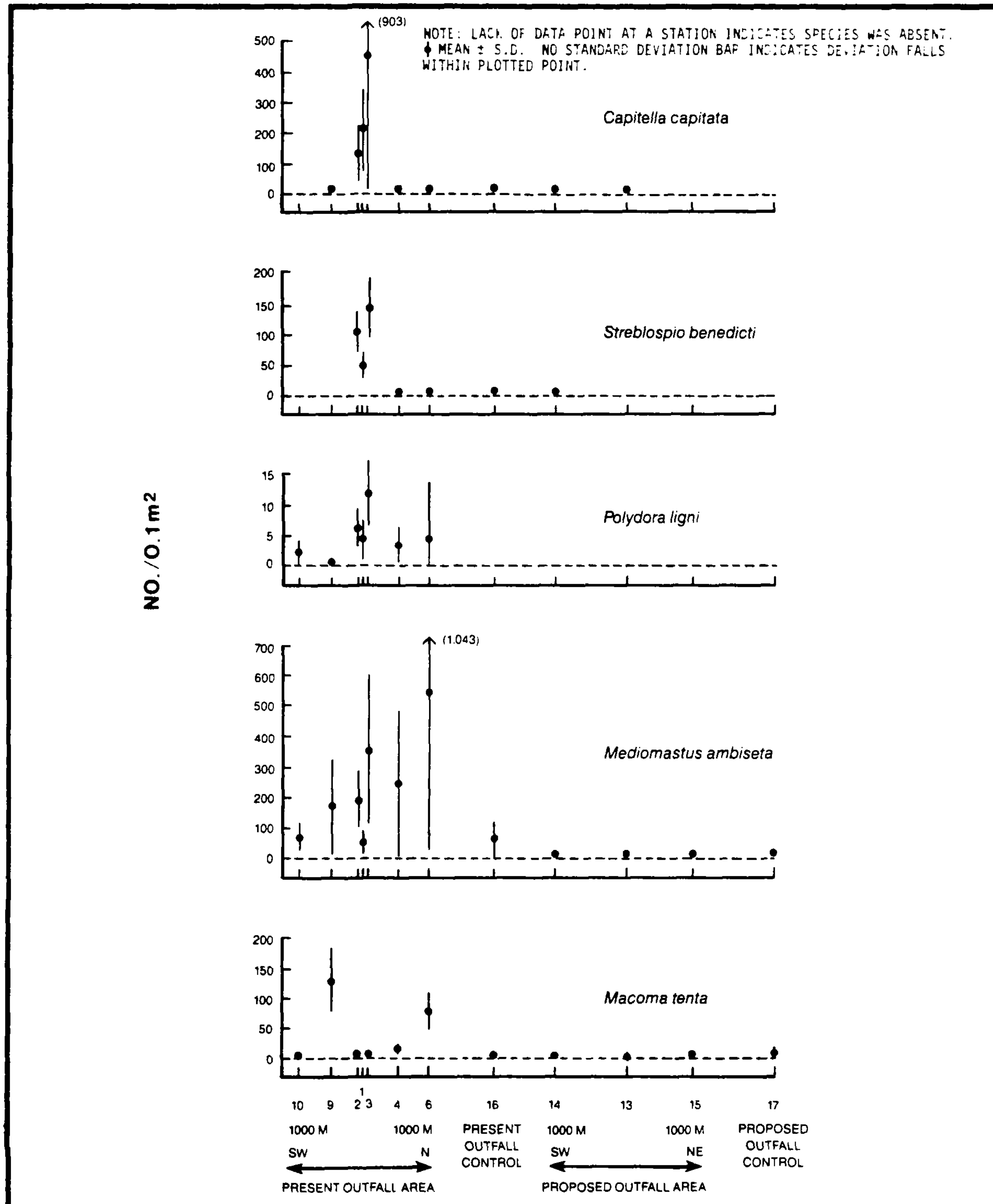


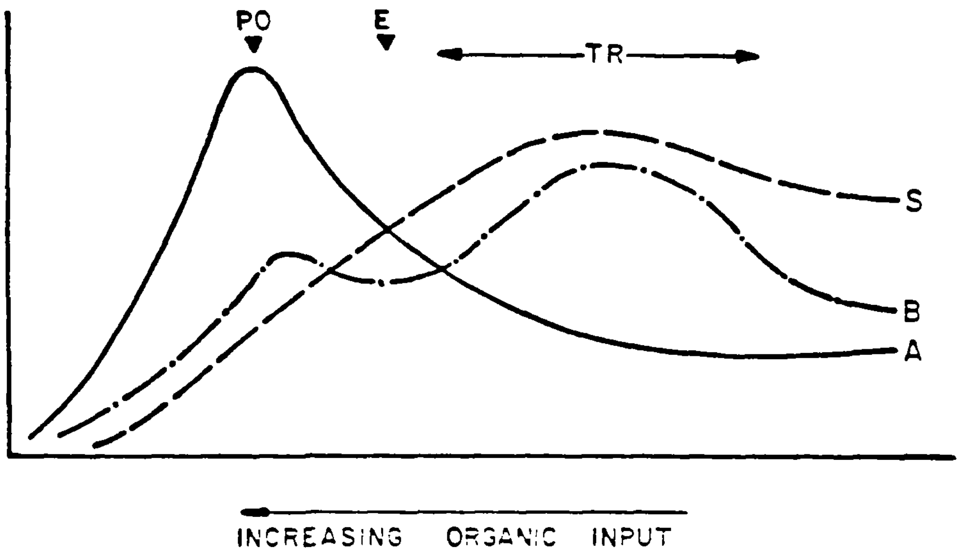
Figure 7. Abundances of opportunistic species indicative of organic enrichment near the existing and proposed discharge areas and at control sites.

enrichment (e.g., Pearson and Rosenberg 1978). For example, Capitella capitata and Streblospio benedicti are abundant only in the immediate vicinity of the discharge, whereas Macoma tenta appears to be a transition zone species, reaching its peak abundances at Stations 6 and 9. Possible reasons for asymmetrical effects of the discharge are discussed later in this section.

In summary, benthic infaunal communities at stations within 1.0 km (0.6 mi) north and 0.5 km (0.3 mi) southwest of the existing discharge are generally dominated by opportunistic or pollution-tolerant species characteristic of disturbed habitats. Capitella capitata is a dominant species in the immediate vicinity of the existing discharge. The results of classification analysis were related to spatial effects of the existing discharge, and showed four station groups: 1) Stations 1, 2, and 3 within and just beyond the existing ZID; 2) Stations 4, 6, 9, and 10 which are considered farfield sites with respect to the existing discharge; 3) Stations 15 and 16, near the proposed discharge site and at the control area for the existing discharge, respectively; and 4) Stations 13, 14, and 17 near the proposed discharge site and its control area. Species richness was significantly higher at sites 1.0 km (0.6 mi) away from the existing discharge than within the existing ZID, although the number of taxa at the existing discharge site was similar to that of the corresponding control area (Figure 3).

Total infaunal abundance generally increased with distance from the existing discharge, but again the within-ZID station was similar to the corresponding control site (Figure 4). Species distributions and infaunal community parameters indicate that infaunal assemblages within and immediately beyond the ZID of the existing discharge may be beyond the peak of opportunists associated with an environmental gradient of increasing organic enrichment (see Figure 8 and Pearson and Rosenberg 1978). In evaluating data from earlier benthic surveys conducted by the applicant, Tetra Tech (1981) reached a similar conclusion.

In addition, the results of the 1983 survey suggest that effects of the discharge may be asymmetrical. Species richness at Station 10, located



S = Species numbers
A = Total abundance
B = Total biomass
PO = Peak of opportunists
E = Ecotone point
TR = Transition zone

SOURCE: PEARSON & ROSENBERG 1978

Figure 8. Generalized species number, abundance, and biomass diagram showing changes along a gradient of organic enrichment.

1.0 km (0.6 mi) southwest of the existing discharge site, was significantly higher than at Station 6, located 1.0 km (0.6 mi) north of the existing discharge (Figure 3). First, Station 10 had a somewhat different set of dominant taxa than did other stations in Station Group 3, as indicated by the relatively low similarity between Station 10 and Stations 4, 6, and 9 (Figure 5). At the latter stations, the bivalve Nucula proxima and the opportunistic species Mediomastus ambiseta and Mulinia lateralis were dominant, whereas cirratulid polychaetes and the gastropods Crepidula spp. and Odostomia seminuda were most abundant at Station 10. Species characteristic of sandy sediments (e.g., Tellina agilis and Ampelisca vadorum) were relatively abundant at Station 10, but poorly represented at Stations 4, 6, and 9. Second, all four of the opportunistic indicator species (Capitella capitata, Polydora ligni, Streblospio benedicti, and Mediomastus ambiseta) were more abundant at Station 3 just north of the ZID boundary than at Station 2 just south of the ZID boundary (Figure 7). The standard deviations for mean species abundances shown in Figure 7 suggest that differences in individual species abundances between Stations 2 and 3 were not statistically significant. The statistical significance of the overall trend involving the four species could not be determined as part of this review, since data for individual replicate samples were not available. Asymmetrical spatial patterns around the existing discharge may be related to influences of currents and natural sediment conditions on species composition and community structure, rather than any effect of the discharge per se. Accordingly, Stations 3 and 10 have sandier sediments than do Stations 2 and 6. Alternatively, asymmetrical spatial patterns may be related to discharges (combined sewer overflows) from the auxilliary outfall located north of the main existing outfall. As reported by the applicant, storms result in frequent discharges from the auxilliary outfall. These overflow discharges would be expected to affect stations north of the existing discharge more than those southwest of the existing discharge.

At the proposed discharge, infaunal communities were dominated by species characteristic of the Nucula-Nephtys community described by Sanders (1958, 1960) for soft-bottom sites throughout Buzzards Bay. Typical species of this assemblage include Nucula proxima, Nephtys incisa, Pitar morrhuana, Lumbrineris spp., Ninoe nigripes, and Paraonis gracilis. Station 15 was slightly different from other sites near the proposed discharge because of its sandier sediments and dominant species characteristic of sandy habitats (e.g., the bivalve *Cerastoderma pinnulatum*, the amphipod *Ampelisca verrilli*, and the polychaete *Scalibregma inflatum*).

Fishes and Trawl-Caught Macroinvertebrates

The results of a 1-day trawl survey discussed in the original application were so limited that it was virtually impossible to draw firm conclusions regarding the species composition, abundance, dominance, and diversity of the local fish community, or to assess potential impacts on this community of the New Bedford discharge (Tetra Tech 1981). In support of the revised application, additional sampling of fishes was conducted on two occasions in 1983, using an otter trawl and gill nets.

Four stations (2, 13, 16, and 17) were sampled by otter trawl during each survey period (August and October, 1983). Mini-ranger coordinates giving exact station locations are summarized in the applicant's Table IC2 and shown in Figure 2. Station designations and depths were as follows:

- Station 2 (existing ZID boundary) - 10 m (32.8 ft)
- Station 13 (proposed discharge site) - 13.7 m (44.9 ft)
- Station 16 (shallow-water reference site) - 8.0 m (26.2 ft)
- Station 17 (deep-water reference site) - 13.7 m (44.9 ft).

The shallow-water reference site was located east of Nasketucket Bay, about 10.0 km (6.2 mi) from the existing discharge site. The deep-water reference site was located in Buzzards Bay, about 10.2 km (6.3 mi) east of the proposed discharge site.

Sampling was conducted with a 7.6-m (25-ft) Marinovich semi-balloon otter trawl constructed with appropriately-sized mesh. Single 10-min trawls were conducted in a southeasterly direction at each station, passing by the station marker at mid-point. Upon retrieval of the trawl, all fishes were identified, counted, and inspected for disease. Up to 50 fish of each species were then subsampled for total length, which was measured to the nearest millimeter. These methods are generally appropriate for semiquantitative characterization of demersal fishes and epibenthic macroinvertebrates in shallow coastal waters (Mearns and Allen 1978; Hayes 1983). However, provisions for preservation of representative specimens as well as taxonomic verification are not discussed by the applicant.

In addition to the otter trawl, four stations were sampled during each survey period (August and October, 1983) by gill net. However, data from gill net sampling were too few to be useful in characterization of the fish community, and will therefore not be reviewed in this report.

The applicant indicates that biological community data were analyzed using a variety of statistical procedures. Both numerical and nodal analyses were performed on transformed data ($\log_{10}$ x+1) utilizing the Bray-Curtis similarity index (Sneath and Sokal 1973; Clifford and Stephenson 1975; Boesch 1977). However, the applicant does not discuss numerical classification or nodal analysis of the fish data in the results section, presumably because of the small size of the data set. The applicant's analyses are limited to calculation of number of species, abundance, and the Shannon-Wiener index of diversity and its evenness component (Shannon and Weaver 1949).

The eight 10-min tows yielded a total of 1,761 fish from 14 species. The average number of fish per trawl was 220 and the median number of fish per trawl was 196. In most instances, sample size of trawl-caught fishes was adequate, and fell within the range of 200-1,000 individuals recommended by Mearns and Allen (1978). However, the August sampling of Station 13 and the October sampling of Stations 13 and 17 yielded less than 100 fish each. Therefore, the overall level of sampling effort described by the applicant was inadequate for characterization of fishes in the vicinity of the proposed discharge and at the deep-water reference site (Mearns and Allen 1978; Saville 1977). Total numbers of fishes caught were greatest near the existing discharge, intermediate in control areas, and lowest near the proposed discharge.

In terms of relative abundance, six species accounted for 99 percent of the fishes collected in both the August and October sampling periods. These were:

- Scup (*Stenotomus chrysops*) - 81% percent
- Black sea bass (*Centropristis striata*) - 13 percent
- Winter flounder (*Pseudopleuronectes americanus*) - 2 percent
- Bay anchovy (*Anchoa mitchilli*) - 1 percent
- Northern searobin (*Prionotus carolinus*) - 1 percent
- Fourbeard rockling (*Enchelyopus cimbrius*) - 1 percent.

Eight additional species accounted for the remainder of fishes collected: butterfish (*Peprilus triacanthus*), cunner (*Tautogolabrus adspersus*), summer flounder (*Paralichthys dentatus*), northern pipefish (*Syngnathus fuscus*), tautog (*Tautoga onitis*), pinfish (*Lagodon rhomboides*), seaboard goby (*Gobiosoma ginsburgi*), and guaguanche (*Sphyraena guachancho*).

The total number of fishes caught in October (526) was less than half of that in August (1,235). This reduced abundance is probably a reflection of the seasonal offshore migration of scup and black sea bass, which usually leave the nearshore environment by late October (Bigelow and Schroeder 1953).

Scup dominated the catch at all four stations during the August sampling and at three of the four stations during the October sampling. The deep-water reference site was about equally represented by scup (36 specimens) and black sea bass (37 specimens) during the October sampling. Scup, black sea bass, and northern searobin were the most frequently sampled species. Scup and black sea bass occurred in all trawl samples, while northern searobin were missing from only the October sampling of the deep-water reference site (Station 17).

Juvenile fishes made up a large proportion of the catch. Fish length data from the trawl samples indicate that 319 (99 percent) of the 323 scup measured during the present study were less than 110 mm (4.3 in) long, and were therefore juvenile or young-of-the-year fishes (Bigelow and Schroeder 1953). All of the black sea bass caught were juveniles less than 90 mm (3.5 in) long. Mean length of both scup and black sea bass increased between the August and October sampling dates, indicating continued feeding and growth during that period.

Data pooled for the August and October sampling periods indicate that the number of species was greatest at the present discharge site (12 species), lowest at the proposed discharge site (4 species), and intermediate for the two reference sites (7 species at each). Diversity was lowest at the existing discharge site (0.64) because of the overwhelming dominance of a single species, scup. Diversity was greatest (1.60) at the proposed discharge site, even though abundance and number of species were least at this station. High diversity in this case was presumably the result of diminished dominance of scup, as indicated in the comparatively high evenness index (0.8). The diversity index was 1.23 at the shallow-water reference site and 0.86 at the deep-water reference site.

Eight species were found at only one of the sample sites. A single specimen of tautog occurred at the shallow-water reference site. Seven species occurred only at the existing discharge station. These were the bay anchovy, butterfish, northern pipefish, pinfish, seaboard goby, and guaguanche. Also, 28 of the 29 specimens (97 percent) of winter flounder were found at the existing discharge station.

According to the applicant, none of the differences in species abundance, richness, or diversity of trawl-caught fishes among stations were substantial enough to be considered significant. However, the applicant does not indicate whether any statistical comparisons were made to substantiate this claim.

The applicant summarizes the results of trawl surveys that have been conducted by the Massachusetts Division of Marine Fisheries (MDMF) in the vicinity of the existing and proposed outfall sites (Figure 2). Sampling was conducted semiannually in May and September, 1978-1983. Twenty-minute tows of a 39/51 Whiting trawl were taken at a tow speed of 1.27 m/sec (2.5 knots), each covering a distance of about 1,500 m (5,000 ft). Trawl stations were located about 2 km (1.24 mi) southwest of the existing discharge and about 1.5 km (0.93 mi) south of the proposed discharge. Details concerning design of sampling gear were not provided by the applicant. Therefore, personnel with the MDMF were consulted about design and methodology employed in use of the 39/51 Whiting trawl.

The Whiting trawl is a type of otter-trawl that is equipped with an 11.9-m (39-ft) headrope and an 18-m (51-ft) footrope (Howe, A., 6 March 1984, personal communication). Features that are not found in the typical Marinovich trawl include a rubber-dish chainsweep attached to the footrope and chains that extend from each otter board to the wing of the net. The function of the chains is to stir up the bottom and create a cloud of sediments that "herds" the fish into the mouth of the net. Mesh size ranged from 6.4 to 8.9 cm (2.5 to 3.5 in) in the body of the net to 0.64-cm (0.25-in) in the mesh liner of the cod end. Gear selection and methodology were therefore appropriate for semiquantitative characterization of demersal fishes in coastal waters (Hayes 1983), but differed significantly from those recommended by Mearns and Allen (1978) and employed by the applicant.

Individual species caught, their average seasonal abundances, and total numbers of specimens from each of the MDMF sampling areas are listed in the applicant's Tables IC21 and IC22. According to the applicant, these data indicate a more abundant and diverse community than that described in the applicant's survey. The applicant further suggests that these differences are attributable to the longer towing time and larger net used by MDMF. This is a reasonable assumption since differences in size of the two nets and length of tow may well account for much of the order of magnitude difference in catch per trawl between the two surveys. For instance, calculation from distance towed and footrope length for each type of net shows that the area trawled by the Marinovich net was 0.58 hectare (1.43 acres) and the area trawled by the Whiting net was 2.74 hectares (6.77 acres).

It should also be noted that the applicant's comparison of the two data sets may be seasonally biased in several ways. The total number of fishes caught in the vicinity of the existing discharge is seasonally biased by unequal sampling effort. The area near the existing discharge was sampled on five occasions in May (1979, 1980, 1981, 1982, and 1983) and on three occasions in September (1978, 1980, and 1982). The area near the proposed discharge was sampled twice in May (1979 and 1981) and twice in September (1981 and 1982). Also, comparison of MDMF data, which was collected in May and September, with the applicant's data, which was collected in August and October, introduces a second seasonal bias. Many species of fishes are highly migratory, moving onshore with seasonal warming of coastal waters in the spring and offshore with seasonal cooling in the fall. The timing of seasonal patterns of movement can vary considerably among species. Therefore, a more useful comparison, performed as part of this review, is between density data (i.e., number of specimens per hectare) from the September MDMF surveys with pooled data for August and October from the revised application.

Numbers of species, abundances, and diversities of fishes caught in the late summer and early fall were greater at the MDMF trawl stations sampled with the Whiting trawl than at stations sampled with the Marinovich trawl. In the MDMF survey, 16 species of fishes were found in the area of the existing discharge and 21 species were found in the area of the proposed discharge. Although the Whiting trawl collected more species than the Marinovich trawl, overall abundance was again dominated by a few species. Scup and striped anchovy (<u>Anchoa hepsetus</u>) accounted for over 95 percent of the fishes caught by Whiting trawl in September near the existing discharge. Similarly, scup, butterfish, and silver hake (<u>Merluccius bilinearis</u>) accounted for over 95 percent of the fishes caught in the area of the proposed discharge.

Therefore, scup were the predominant trawl-caught fish during the August-October sampling period. Density of scup at nearshore stations was 801/hectare at the existing discharge site (Station 2 in Figure 2), 716/hectare at the MDMF farfield site, and 189/hectare at the reference site (Station 16 in Figure 2). Density of scup at offshore locations was 28/hectare at the proposed discharge site (Station 13 in Figure 2), 372/hectare at the MDMF offshore site, and 212/hectare at the reference site (Station 17 in Figure 2).

An important taxonomic group that occurred in relatively low densities was the flatfishes. Four species of flounder were present in the surveys: winter flounder, summer flounder, windowpane flounder (Scophthalmus aquosus), and fourspot flounder (Paralichthys oblongus). Winter and summer flounder were the only species sampled in the applicant's August-October survey of the area, whereas all four species were present in the MDMF survey. Densities of flounder at nearshore locations were 24.2/hectare at the existing discharge site (Station 2 in Figure 2), 5.1/hectare at the MDMF farfield site, and 0.9/hectare at the reference site (Station 16 in Figure 2). Densities of flounder at offshore locations were 4.7/hectare at the MDMF offshore station and 1.7/hectare at the reference site (Station 17 in Figure 2). No flounder were collected at the proposed discharge site. These results suggest that flounder, like scup, occur in higher densities around the existing discharge than they do elsewhere in the study area.

Trawl-caught macroinvertebrates were collected in the MDMF survey, but were omitted from the applicant's study, which focused on fishes, although presumably macroinvertebrates were sampled as well. This is an important omission because squid were a major taxonomic category in the MDMF surveys. Relative abundance of longfin squid (Loligo pealei) was 41.0 percent (by number) of the total catch in the area of the existing discharge, and 12.6 percent in the area of the proposed discharge. The applicant mistakenly indicates that a second species of squid, "Loligo" squid, was collected in the area of the proposed discharge during the MDMF surveys. Apparently two common names were used for Loligo pealei in the MDMF cruise summaries (Howe, A., 14 March 1984, personal communication), and the synonomy was not recognized during preparation of the revised application. These data suggest that longfin squid are an important constituent of the pelagic community in the vicinity of the existing and improved discharge sites.

Buzzards Bay and adjacent waters of Martha's Vineyard, Vineyard Sound, and Nantucket Sound are a major spawning area for longfin squid (Howe, A., 14 March 1984, personal communication). There is no squid fishery in Buzzards Bay because the bay has been closed to trawling since the early 1920s (Howe, A., 14 March 1984, personal communication). However, remaining areas around Buzzards Bay support extremely productive squid fisheries.

Two studies of demersal fishes in Narragansett Bay, Rhode Island, provide a regional basis for comparison with the fishes observed in the New Bedford area (Oviatt and Nixon 1973; Jeffries and Johnson 1974). According to the applicant, salinity, temperature, and depth characteristics of Narragansett Bay are similar to those of the New Bedford study area. The number of species was greater in Narragansett Bay than in the New Bedford area. As the applicant points out, this greater diversity was undoubtedly due to the greater number of samples taken throughout the year in the two Narragansett Bay studies. However, the pattern of abundance was similar for the two areas. A few dominant species accounted for the majority of specimens collected. Winter flounder and windowpane flounder were the dominant species in Narragansett Bay, and these species occur there throughout the year. The next two most abundant species were scup and butterfish, which occurred seasonally in the summer and fall. During the August-October period, average densities of fishes in Narragansett Bay were about 49/hectare for scup, and 7-12/hectare for butterfish (Oviatt and Nixon 1973). Thus, densities of winter flounder and windowpane flounder were greater in Narragansett Bay than in the New Bedford study area. Densities of butterfish were generally comparable between the two areas, although the average density in the MDMF surveys for the area near the proposed discharge was 89 fish/hectare. Densities of scup in the 1971 survey of Narragansett Bay were less than those observed at the existing discharge site (Station 2) and at the MDMF nearshore sampling area, but were within the range of those observed at the remaining sampling sites in the New Bedford area.

2. *Are distinctive habitats of limited distribution (such as kelp beds or coral reefs) located in areas potentially affected by the modified discharge? [40 CFR 125.61(c)] If*

yes, provide information on type, extent, and location of habitats.

The applicant states that no coral reefs, kelp beds, seagrass beds, or marine/estuarine sanctuaries exist within the area potentially influenced by the modified discharge. Available information confirms the applicant's statement that no distinctive habitats of limited distribution are present near the proposed discharge site. For example, J. Costa (6 April 1984, personal communication) of the Marine Biological Laboratory at Woods Hole indicated that eelgrass beds are absent from offshore areas of Buzzards Bay and New Bedford Harbor. Moreover, eelgrass in Buzzards Bay is generally restricted to water depths less than 5.5 m (18 ft) below MLLW. Although there are extensive eelgrass beds in eastern Buzzards Bay, and along the western shore near Westport, information on the spatial distribution of eelgrass is limited. Eelgrass beds may be present in Apponagansett Bay in areas located approximately 8-10 km (5.0-6.2 mi) from the proposed discharge site.

Buzzards Bay is part of the Cape and Islands Ocean Sanctuary established in 1971 (Bliven, S., 5 April 1984, personal communication). Alteration or removal of bottom sediments, and dumping of commercial/industrial wastes, are prohibited in the sanctuary.

3. *Are commercial or recreational fisheries located in areas potentially affected by the discharge? [40 CFR 125.61(c)] If yes, provide information on types, location, and value of fisheries.*

According to the applicant, commercially important species that occur in the area of the existing outfall are hardshell clams (Mercenaria mercenaria) and lobster (Homarus americanus). Recreationally important species are bay scallops (Argopecten irradians), scup, bluefish (Pomatomus saltatrix), striped bass (Morone saxatilis), and Atlantic mackerel (Scomber scombrus). Other commercially or recreationally important species present in trawl collections conducted either by the applicant or by MDMF are menhaden (Brevoortia tyrannus), Atlantic herring, summer flounder, winter flounder, black sea bass, butterfish, silver hake, American shad (Alosa sapidissima) and longfin squid (Bigelow and Schroeder 1953; Saila and Pratt 1973; Charron 1980). With the exception of a small area that is open to harvest of hardshell clams and bay scallops, there is virtually no commercial fishing of any kind in the vicinity of the existing discharge (i.e., outer New Bedford Harbor) because of prohibition of trawling gear in Buzzards Bay, poor water quality conditions, and contamination by PCBs (Figure 9) (Tetra Tech 1981; Weaver 1984; Howe, A., 14 March 1984, personal communication).

The applicant indicates that no data are available on the value of commercial or recreational lobstering conducted in the area. However, the estimated value of the lobster fishery in the area of New Bedford Harbor exceeded $125,000 in 1977 (Kolek and Ceurvels 1981; Tetra Tech 1981). As part of the surveys conducted in support of the original application, shellfish dredging was conducted in the area of the proposed discharge and at a second, unspecified, control station. No shellfish were found in either area.

According to the applicant, recreational scalloping is permitted over the entire outer harbor area, but only five family permits were issued in 1983. However, the depressed scallop fishery is a regional phenomenon and cannot be attributed to adverse effects of the New Bedford discharge. Recreational fishing for scallops in inshore areas along the whole south coast of Massachusetts has been poor in the past 10 years (Kolek, A., 19 April 1984, personal communication). There are always small seed scallops, but rarely enough larger, adult scallops to warrant heavy fishing pressure. Harvest in a good year may be as much as 5 bushels in 3 or 4 hours, but is more typically on the order of 1 bushel in a full day. Therefore, the number of permits issued is usually low (e.g., 3-4 in a year), but increases greatly to about 200 in a year when there is a good scallop set.

As part of this review, further details concerning recreational fishing and shellfishing were obtained in an interview with personnel of the Massachusetts Division of Marine Fisheries (Kolek, A., 19 April 1984, personal communication). The following information is a summary of that interview.

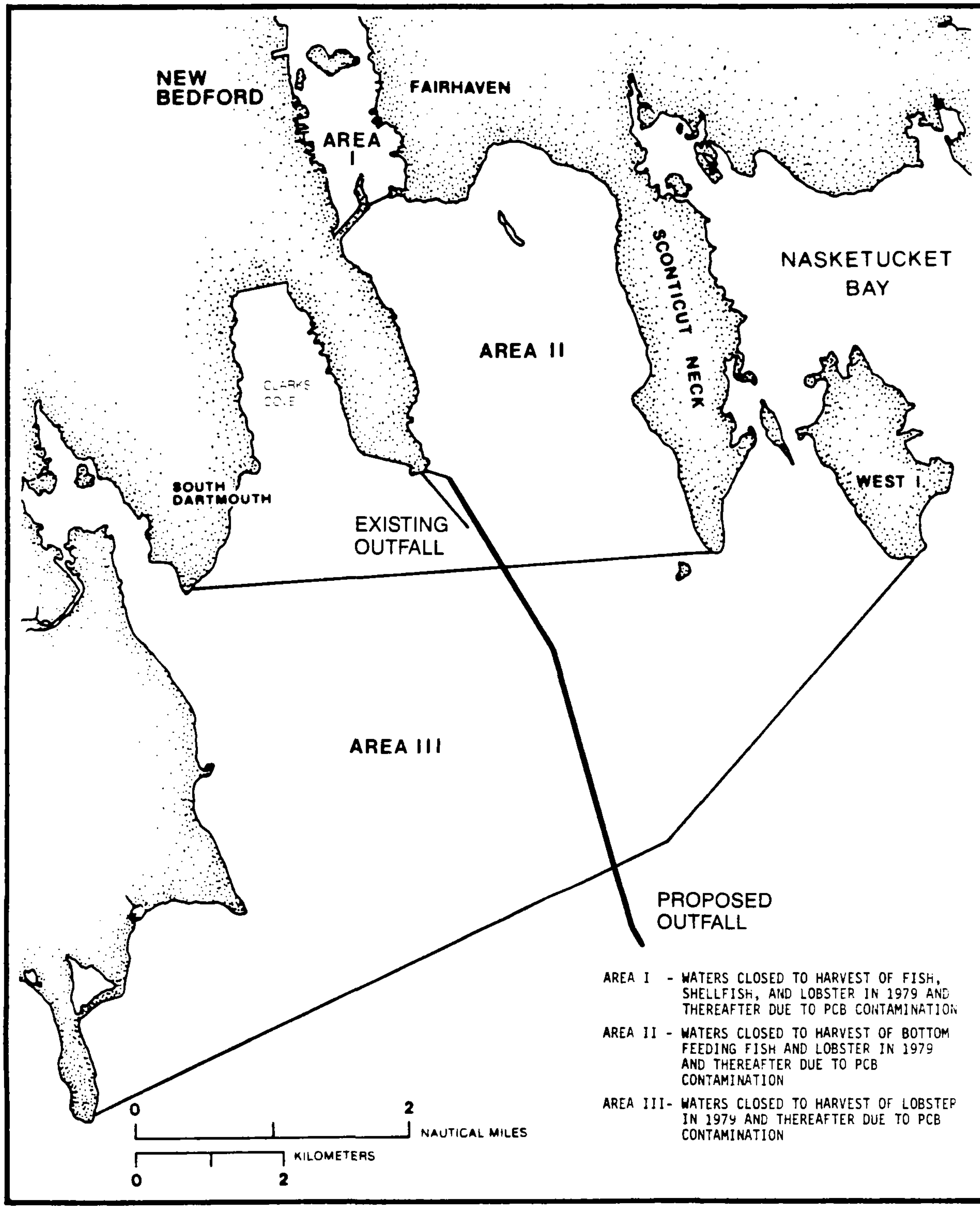


Figure 9. Location of areas closed to commercial and recreational fisheries due to PCB contamination.

Sport fishing in the vicinity of New Bedford Harbor is a common summer recreational activity typical of a coastal community. It is pursued extensively from the Dartmouth and Fairhaven shorelines, from jetties at Clarks Point, and from boats in the outer harbor. Principal fish species caught in the recreational fishery are scup, tautog, summer flounder, winter flounder, bluefish, and striped bass. Scup and tautog are caught extensively as food fish, particularly by members of the Portuguese ethnic community. Areas of heavy fishing pressure for scup are rocky ledges near Wilbur Point. Other bottom-feeding fishes such as summer and winter flounder receive less pressure than do scup and tautog, and are fished principally from shore. Recreational fishing for bottom-feeding fishes in the outer harbor area is prohibited because of PCB contamination (Figure 9). However, closures are not enforced and public awareness of PCB contamination has had little impact on bottom-fishing activity. Bluefish are the principal gamefish in the outer harbor, and are fished from boats in the Egg Island and Little Egg Island areas. Striped bass were a favored gamefish, but have declined in abundance over recent years to the point where they no longer afford a significant recreational opportunity. Quantitative sampling of the recreational fishery has not been performed. Therefore, there are no estimates of the economic value of the fishery.

Lobstering is a popular recreational fishery, with the state of Massachusetts issuing over 10,000 permits per year. Recreational fishing for lobster occurs throughout New Bedford Harbor, but is prohibited by the same PCB closures that affect the commercial lobster fishery (Figure 9). However, the PCB closures are not strictly enforced for the recreational harvest of lobsters in closure areas II and III. Public awareness of PCB contamination has had no effect on lobstering in closure area III, but has diminished lobstering in area II to an estimated 10-25 percent of its historical level. Recreational lobstering occurs in the area of the existing outfall, especially close to shore where rock rip-rap provides cover for lobsters. However, there is no known direct impact of the existing discharge on the lobster fishery. Quantitative sampling of the recreational fishery for lobster has not been performed. Therefore, there are no estimates of the economic value of the fishery.

D. State and Federal Laws [40 CFR 125.60]

1. Are there water quality standards applicable to the following pollutants for which a modification is requested:

- *Biochemical oxygen demand or dissolved oxygen?*
- *Suspended solids, turbidity, light transmission, light scattering, or maintenance of the euphotic zone?*
- *pH of the receiving water?*

The Commonwealth of Massachusetts has adopted water quality standards for coastal and marine waters. Quantitative standards for dissolved oxygen, total coliform bacteria, and pH have been established for the area of the proposed discharge. Qualitative standards exist for turbidity, color, floating material and substances, and total suspended solids.

2. If yes, what is the water use classification for your discharge area? What are the applicable standards for your discharge area for each of the parameters for which a modification is requested? Provide a copy of all applicable water quality standards or a citation to where they can be found.

The waters in the vicinity of the existing and proposed outfall are designated Class SA by the Commonwealth of Massachusetts. The applicant lists the minimum standards for Commonwealth waters and the additional minimum standards for coastal and marine waters in Table ID1 of the revised application. Applicable Massachusetts receiving water quality standards for the New Bedford outfall vicinity are given in Table 8.

3. Will the modified discharge: [40 CFR 125.59(b)(3)]

- *Be consistent with applicable State coastal zone management program(s) approved under the Coastal Zone Management Act as amended, 16 U.S.C. 1451 et seq.? [See 16 U.S.C. 1456(c)(3)(A)]*

TABLE 8. MASSACHUSETTS WATER QUALITY STANDARDS APPLICABLE TO CLASS SA WATERS

A. These minimum criteria are applicable to all waters of the Commonwealth, unless criteria specified for individual classes are more stringent.

	Parameter	Criteria
1.	Aesthetics	All waters shall be free from pollutants in concentrations or combinations that: a) Settle to form objectionable deposits; b) Float as debris, scum, or other matter to form nuisances; c) Produce objectionable odor, color, taste, or turbidity; or d) Result in the dominance of nuisance species.
2.	Radioactive substances	Shall not exceed the recommended limits of the United States Environmental Protection Agency's National Drinking Water Regulations.
3.	Tainting substances	Shall not be in concentrations or combinations that produce undesirable flavors in the edible portions of aquatic organisms.
4.	Color, turbidity, total suspended solids	Shall not be in concentrations or combinations that would exceed the recommended limits on the most sensitive receiving water use.
5.	Oil and grease	The water surface shall be free from floating oils, grease, and petrochemicals, and any concentrations or combinations in the water column or sediments that are aesthetically objectionable or deleterious to the biota are prohibited. For oil and grease of petroleum origin, the maximum allowable discharge concentration is 15 mg/l.
6.	Nutrients	Shall not exceed the site-specific limits necessary to control accelerated or cultural eutrophication.
7.	Other constituents	Waters shall be free from pollutants in concentrations or combinations that: a) Exceed the recommended limits on the most-sensitive receiving water use; b) Injure, are toxic to, or produce adverse physiological or behavioral responses in humans or aquatic life; or c) Exceed site-specific safe exposure levels determined by bioassay using sensitive resident species.

B. Coastal and Marine Waters - the following additional minimum criteria are applicable to coastal and marine waters.

For Class SA waters:

	Parameter	Criteria
1.	Dissolved oxygen	Shall be a minimum of 6.0 mg/l.[a]
2.	Temperature	None except where the increase will not exceed the recommended limits on the most sensitive water use.
3.	pH	Shall be in the range of 6.5 - 8.5 standard units and not more than 0.2 units outside of the naturally-occurring range.
4.	Total coliform bacteria	Shall not exceed a median value of 70 MPN per 100 ml and not more than 10 percent of the samples shall exceed 230 MPN per 100 ml in any monthly sampling period.

[a] The criteria of 6 mg/l (or 85 percent saturation where appropriate) is based on the depth-integrated (i.e., depth-averaged) mean dissolved oxygen concentrations. Therefore, water column values of less than 6 mg/l are acceptable, provided this does not in the judgment of the Massachusetts Department of Environmental Quality Engineering, Division of Water Pollution Control, interfere with the maintenance of a balanced indigenous population (McMahon, T.C., 15 December 1983, personal communication).

Source: Commonwealth of Massachusetts Water Quality Standards of September, 1978.

- *Be located in a marine sanctuary designated under Title III of the Marine Protection, Research, and Sanctuaries Act (MPRSA) as amended, 16 U.S.C. 1431 et seq. or in an estuarine sanctuary designated under the Coastal Zone Management Act as amended, 16 U.S.C. 1461? If located in a marine sanctuary designated under Title III of the MPRSA, attach a copy of any certification or permit required under regulations governing such marine sanctuary. [See 16 U.S.C. 1432(f)(2)]*
- *Be consistent with the Endangered Species Act as amended, 16 U.S.C. 1531 et seq.? Provide the names of any threatened or endangered species that inhabit or obtain nutrients from waters that may be affected by the modified discharge. Identify any critical habitat that may be affected by the modified discharge and evaluate whether the modified discharge will affect threatened or endangered species or modify a critical habitat. [See 16 U.S.C. 1536(a)(2)]*

The modified discharge will be located in an area which is under jurisdiction of the Commonwealth of Massachusetts Regulations on Ocean Sanctuaries, which has been approved under the Coastal Zone Management Act of 1972. The Department of Environmental Management has confirmed this in a letter received by the applicant on August 30, 1979. In a letter to the applicant dated November 21, 1983, the Department of Environmental Management stated that the proposed outfall extension complies with the provisions of the Ocean Sanctuaries Act.

The modified discharge is not located in a marine or estuarine sanctuary designated under Title III of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended, or under the Coastal Zone Management Act of 1972. This has been confirmed by a letter dated August 11, 1980, from the National Oceanic and Atmospheric Administration (NOAA).

According to the applicant, the National Marine Fisheries Service indicated that three species of threatened or endangered sea turtles are summer inhabitants of southern New England waters. The species of concern are:

- Loggerhead sea turtle (Caretta caretta) - threatened
- Atlantic Ridley sea turtle (Lepidochelys kempii) - endangered
- Leatherback sea turtle (Dermochelys coriacea) - endangered.

The applicant reports that it cannot be conclusively stated whether or not any of these species of turtles would be found in the vicinity of the modified discharge.

> 4. *Are you aware of any State or Federal Laws or regulations (other than the Clean Water Act or the three statutes identified in item 3 above) or an Executive Order which is applicable to your discharge? If yes, provide sufficient information to demonstrate that your modified discharge will comply with such law(s), regulation(s), or order(s). [40 CFR 125.59(b)(3)]*

The applicant does not discuss any other federal laws applicable to the discharge. Massachusetts water quality standards require, at a minimum, primary treatment and disinfection of municipal wastewater prior to discharge to coastal and marine waters. Higher levels of treatment may be required if necessary to satisfy other state and federal laws and regulations.

III. *TECHNICAL EVALUATION*

A. *Physical Characteristics of Discharge [40 CFR 125.61(a)]*

> 1. *What is the critical initial dilution for your current and modified discharge(s) during 1) the period(s) of maximum stratification? and 2) any other critical period(s) of discharge volume/composition, water quality, biological seasons, or oceanographic conditions?*

The applicant estimates a critical flux-averaged initial dilution for the modified discharge of 28:1 at a trapping depth of 2.7 m (8.9 ft) for the period of maximum stratification (July and August). The initial dilution was determined using the PLUME model, a uniform density gradient of 0.242 $kg/m^3/m$, and a discharge flow rate of 1.00 m^3/sec (22.8 MGD), the current average annual flow. The applicant also reports dilutions of 25:1 for a flow of 1.70 m^3/sec (38.8 MGD), and 34:1 for a flow of 0.44 m^3/sec (10.0 MGD).

Minimum initial dilutions were recalculated as part of this review using the EPA-approved mathematical model PLUME and flows representative of the end of permit year (1989). The results are presented in Table 9. The minimum initial dilution under stratification conditions actually measured in the vicinity of the proposed diffuser is 26.5:1 for the July 22, 1980, density profile at Station E. A comparable dilution (26.8:1) was calculated for a July 28, 1979, density profile at Station C near the proposed location of the new diffuser. The applicant's dilution for the same flow and the assumed "worst case" density gradient is 20.4:1. However, this dilution is not considered further herein since the assumed profile represents a composite of profiles occurring not only at the proposed discharge site, but also at sites much closer to shore, and therefore may not be representative of conditions at the proposed discharge site. Therefore, the minimum critical initial dilution used in subsequent analyses is 26.5:1.

Initial dilution was also calculated for an assumed well-mixed density profile with no stratification. This is typical of a profile expected during fall, winter, and spring and represents the opposite extreme from the maximum stratification profile. Initial dilution under these conditions is 30.1:1 at 1989 maximum flow, and the effluent plume surfaces.

2. *What are the dimensions of the zone of initial dilution for your modified discharge(s)?*

TABLE 9. SUMMARY OF APPLICANT AND REVIEW INITIAL DILUTIONS AND TRAPPING DEPTHS FOR THE PROPOSED DISCHARGE

Density Profile	Flow[a] m^3/sec	Flow[a] MGD	Source of Calculation	Initial Dilution	Trapping Depth m	Trapping Depth ft
Applicant's "worst case" profile (uniform gradient of 0.242 $kg/m^3/m$)	0.44	10.0	Applicant	34.0	-	-
	0.44	10.0	Review	30.4	4.6	15.1
	1.00	22.8	Applicant	28.0	2.7	8.9
	1.00	22.8	Review	24.7	3.0	9.8
	1.70	38.8	Applicant	25.0	-	-
	1.70	38.8	Review	21.5	1.9	6.2
	2.09	47.7	Review	20.4	1.5	4.9
Station C, 7/28/79	2.09	47.7	Review	26.8	Surface	
Station E, 7/2/80	2.09	47.7	Review	28.7	Surface	
Station E, 7/8/80	2.09	47.7	Review	29.8	Surface	
Station E, 7/22/80	2.09	47.7	Review	26.5	Surface	
Station E, 8/5/80	2.09	47.7	Review	28.0	Surface	
Station E, 8/12/80	2.09	47.7	Review	29.1	Surface	
Station F, 7/22/80	2.09	47.7	Review	31.0	Surface	
Station F, 8/12/80	2.09	47.7	Review	27.7	Surface	
Assumed "minimum stratification" profile	2.09	47.7	Review	30.1	Surface	

[a] Flows represent the following conditions:
Current minimum flow = 0.44 m^3/sec (10.0 MGD)
Current average flow = 1.00 m/sec (22.8 MGD)
Approximate current maximum flow = 1.70 m^3/sec (38.8 MGD)
End-of-permit-term maximum flow = 2.09 m^3/sec (47.7 MGD).

The applicant calculates the ZID dimensions to be 627 m (2,057 ft) long by 27 m (89 ft) wide. The applicant uses a water depth of 13.5 m (44.3 ft) and a diffuser length of 600 m (1,969 ft) in these calculations.

Using the simplified method described by Tetra Tech (1982b), the ZID dimensions were recalculated as part of this review to be 625.2 m (2,051 ft) long by 26.6 m (87.3 ft) wide.

3. *What are the effects of ambient currents and stratification on dispersion and transport of the discharge plume/wastefield?*

The effluent plume is expected to rise to the surface where it will be transported by the instantaneous currents at the site. Currents in the vicinity of the proposed discharge are tidally driven. Current measurements at Station 8, located near the proposed outfall site at a depth of 4.7 m (15.4 ft), best represent ambient conditions likely to affect dispersion of effluent. Progressive vector plots of these current measurements indicate a net northwesterly transport (toward shore) with northeast-southwest tidal oscillations. According to the applicant, the northeast-southwest oscillations have a total magnitude on the order of 2 km (1.2 mi) [i.e., 1 km (0.6 mi) to the northeast followed by 1 km (0.6 mi) to the southwest]. The net transport rate in the northwest direction is estimated by the applicant to be 4 cm/sec (0.13 ft/sec). Progressive vector plots of current measurements from stations northwest of the proposed outfall demonstrate that nearshore mid-depth net currents are directed to the west, implying that a net counter-clockwise circulation pattern exists. Thus, effluent from the proposed discharge will probably circulate initially to the northwest (toward shore), then veer west and south along the shoreline west of the discharge. Current patterns for seasons other than summer are not documented in the application. The applicant asserts that there is little seasonal variation in tidal current patterns.

The results of the initial dilution analyses conducted during this review indicate that at no time is the plume expected to be trapped at a significant depth by ambient density stratification. Thus, aside from the effects on initial dilution, stratification is not expected to affect the dispersion and transport of the effluent plume.

4. Sedimentation of suspended solids.

The applicant uses a particle settling simulation model to calculate the average annual sediment deposition rate. The model incorporates the effects of currents on particle advection calculated from progressive vector plot data. Inputs to the model include a proposed beginning-of-permit term mass emission rate of 4,320 kg/day and a particle settling velocity distribution similar to that described in the Revised Section 301(h) Technical Support Document (TSD) (Tetra Tech 1982b). The applicant calculates a maximum total deposition rate of 106.6 g/m^2/yr over an area of 1 km^2 (0.4 mi^2), and a corresponding organic deposition rate of 85.4 g/m^2/yr over the same area. No information on 90-day and steady state sediment accumulations is provided in the revised application.

The sediment deposition rates were recalculated as part of this review using the simplified model described in Tetra Tech (1982b) and modified inputs. The average plume height of rise was calculated to be 12.0 m (39.4 ft) for both the steady state and 90-day periods. The annual steady state suspended solids mass emission rate was calculated to be 5,110 kg/day (11,266 lb/day), using an annual average flow (1989) of 1.19 m^3/sec (27.0 MGD) and a suspended solids concentration of 50 mg/l. The 90-day critical period rate was calculated to be 9,028 kg/day (19,903 lb/day) using the proposed maximum flow of 2.09 m^3/sec (47.7 MGD) and a suspended solids concentration of 50 mg/l. Current velocities used in these analyses were 15.3 cm/sec (0.50 ft/sec) northeast, 16.7 cm/sec (0.55 ft/sec) southwest, 9.4 cm/sec (0.31 ft/sec) northwest, and 7.3 cm/sec (0.24 ft/sec) southeast. For the steady state case, the maximum total deposition rate was calculated to be 17.1 g/m^2/yr, and the total organic deposition rate was calculated to be 13.7 g/m^2/yr over an area of 6.0 km^2 (2.3 mi^2). Using these values, the maximum steady state organic accumulation was calculated to be 3.8 g/m^2 over the same area. For the 90-day critical case, the maximum total deposition rate was calculated to be 30.3 g/m^2/yr, and the total organic deposition rate was calculated to be 24.2 g/m^2/yr over an area of 6.0 km^2

(2.3 mi^2). Using these values, the maximum 90-day organic accumulation was calculated to be 3.9 g/m^2 over the same area.

Seabed accumulation rates were also calculated using a modified version of the model described in the revised TSD (Tetra Tech 1982b). The modified version includes the effects of current duration (tidal oscillation), and therefore limits the distance that a particle can travel in one direction before flow reversal occurs. Using this method, the maximum total steady state deposition rate was calculated to be 52.4 $g/m^2/yr$, with an organic rate of 41.9 $g/m^2/yr$, over an area of 6.0 km^2 (2.3 mi^2). The maximum steady state organic accumulation was calculated to be 11.5 g/m^2 over the same area. For the 90-day case, the maximum total deposition rate was calculated to be 92.6 $g/m^2/yr$, with a maximum organic rate of 74.1 $g/m^2/yr$, over an area of 6.0 km^2 (2.3 mi^2). The maximum organic accumulation was calculated to be 12.1 g/m^2 over the same area. Based on the results of these two models, the range of maximum organic accumulation is 3.8 g/m^2 to 11.5 g/m^2 for steady state conditions, and 3.9 g/m^2 to 12.1 g/m^2 for the 90-day critical case.

The solids deposition rates calculated above are for the settleable solid fraction of the effluent. Solids transported out of the outfall vicinity are assumed to be colloidal and are expected to remain suspended in the water column indefinitely. Solids deposited within the areas calculated above may be resuspended and transported out of the area. Solids will be transported in a northerly direction with the movement of the near-bottom water. It is expected that the effects of solids deposition outside the outfall vicinity will be minimal.

B. *Compliance with Applicable Water Quality Standards [40 CFR 125.60(b) and 125.61(a)]*

1. *What is the concentration of dissolved oxygen immediately following initial dilution for the period(s) of maximum stratification of any other critical period(s) of discharge volume/composition, water quality, biological seasons, or oceanographic conditions?*

The applicant calculates the dissolved oxygen concentration (DO) following initial dilution to be 6.2 mg/l, using the following equation (Tetra Tech 1982b):

$$DO_f = DO_a + (DO_e - IDOD - DO_a)/S_a$$

where:

DO_f = DO concentration following initial dilution, mg/l
DO_a = ambient DO concentration, mg/l
DO_e = effluent DO concentration, mg/l
IDOD = immediate DO demand, mg/l
S_a = minimum initial dilution.

The applicant's input includes an IDOD of 2.0 mg/l, an ambient dissolved oxygen concentration of 6.3 mg/l, an effluent dissolved oxygen concentration of 6.0 mg/l, and a minimum dilution of 25:1. The applicant also calculates dissolved oxygen concentrations following initial dilution for other flow conditions, travel times, and IDOD values. In all cases, the dissolved oxygen concentration following initial dilution was 6.2 mg/l. Input values selected for this review include an effluent dissolved oxygen concentration of 6.0 mg/l, an ambient dissolved oxygen concentration at the surface of 7.0 mg/l, an ambient dissolved oxygen concentration averaged over the plume rise of 6.7 mg/l, and a minimum dilution of 26.5:1. Using these values and IDOD values of from 2 to 4 mg/l (representative of high and low flow travel times), the final dissolved oxygen concentration after initial dilution was calculated to be 6.6 mg/l. This represents a depression of 5.7 percent using the reference ambient dissolved oxygen concentration measured at the surface, and 1.5 percent when compared to the ambient dissolved oxygen concentration averaged over the plume rise. The EPA calculates percent dissolved oxygen depression using the following equation (Baumgartner 1981):

$$\text{Percent depression} = [(DO_t - DO_e + IDOD)/(DO_t \times S_a)] \times 100$$

where:

DO_t = ambient DO concentration at the trapping level, mg/l.

Using this equation, the percent dissolved oxygen depression is calculated to be 1.6 to 2.7 percent, for the range of IDOD values anticipated..

2. *What is the farfield dissolved oxygen depression and resulting concentration due to BOD exertion of the wastefield during the period(s) of maximum stratification and any other critical period(s)?*

The applicant uses a model similar to the farfield oxygen depletion model described by Tetra Tech (1982b) to predict a minimum farfield dissolved oxygen concentration of 6.2 mg/l at 1.6 days. Inputs to the model include the dissolved oxygen concentrations reported herein in Section III.B.1, an initial dilution of 28:1, effluent carbonaceous and nitrogenous BOD_5 concentrations of 81 mg/l and 17 mg/l, ambient carbonaceous and nitrogenous BOD_5 concentrations of 8 mg/l and 1.5 mg/l, and an ambient temperature of 26.6^o C. The applicant's model assumes a constant subsequent dilution of 7:1 (dilution occurring after the initial dilution) and incorporates the effects of reaeration. The minimum farfield dissolved oxygen concentration was recalculated using the farfield oxygen depletion model of Tetra Tech (1982b), review dissolved oxygen input concentrations reported herein in Section III.B.1, an initial dilution of 26.5:1, and the applicant's effluent carbonaceous and nitrogenous BOD_5 concentrations. Ambient carbonaceous and nitrogenous BOD_5 concentrations are assumed to be 0.0 mg/l in order to calculate only the effect of the effluent BOD exertion on the receiving waters. The minimum farfield dissolved oxygen concentration is predicted to be 6.68 mg/l (i.e., 0.01 mg/l below the plume level after initial mixing). The effects of subsequent dilution predominate, and BOD exertion never significantly depresses the dissolved oxygen concentration below the initial value. Thus, farfield BOD exertion is expected to be negligible.

3. *What are the dissolved oxygen depressions and resulting concentrations near the bottom due to steady sediment demand and resuspension of sediments?*

The applicant uses methods described by Tetra Tech (1982b) to determine the dissolved oxygen depressions due to steady-state sediment demand and sediment resuspension. In calculating the dissolved oxygen depression due to steady-state sediment demand, however, the applicant incorrectly equated the average benthic oxygen demand with the organic sediment deposition rate. Furthermore, the calculations were carried out incorrectly and the revised application contains two reported values for dissolved oxygen depression due to steady-state sediment oxygen demand. The text of the revised application cites a depression of 0.072 mg/l, while the accompanying calculations give a value of 0.056 mg/l.

Steady-state sediment oxygen demand was recalculated as part of this review using parameters reported herein. A dissolved oxygen depression of 0.04 mg/l was calculated using the equation described by Tetra Tech (1982b), an average organic sediment concentration of 10.3 g/m^2, an X_M of 6,610 m (21,686 ft), an H of 1.8 m (5.9 ft), a median current speed of 13.3 cm/sec (0.436 ft/sec), and a conservative subsequent dilution equal to one. This depletion represents a 0.6 percent dissolved oxygen depression when compared to the average ambient dissolved oxygen concentration (6.3 mg/l) over the bottom 1.8 m (5.9 ft). The dissolved oxygen depression was also calculated using the above parameters, but with a conservatively slow current speed of 4.0 cm/sec (0.131 ft/sec) and the resulting H of 3.3 m (10.8 ft). The dissolved oxygen depression under these conditions is 0.06 mg/l, representing a 0.9 percent depression when compared to the average ambient dissolved oxygen concentration of 6.4 mg/l over the bottom 3.3 m (10.8 ft).

The applicant calculates the oxygen depression due to abrupt sediment resuspension using the equation developed by Tetra Tech (1982b). A maximum depletion of 0.067 mg/l is reported in the text of the application, while the subsequently-listed calculations report a value of 0.053 mg/l at 24 h. The dissolved oxygen depression due to sediment resuspension was recalculated as part of this review. Using a sediment concentration of 12.1 g/m^2 and a subsequent dilution equal to one, a maximum depression of 0.11 mg/l was calculated at 24 h.

4. *What is the increase in receiving water suspended solids concentration immediately following initial dilution of the modified discharge(s)?*

The applicant calculates the maximum increase in receiving water suspended solids to be 1.75 mg/l using an ambient suspended solids concentration of 1 mg/l, an effluent suspended solids concentration of 50 mg/l, and an initial dilution of 28:1. Using a minimum initial dilution of 26.5:1 and a receiving water suspended solids concentration of 0.0 mg/l, the maximum increase in receiving water suspended solids was calculated as part of this review to be 1.9 mg/l.

5. *What is the change in receiving water pH immediately following initial dilution of the modified discharge(s)?*

The applicant calculates the maximum change in receiving water pH following initial dilution to be 0.72 units, based on the data from Table VI-11 of the revised TSD (Tetra Tech 1982b). The maximum change in receiving water pH was recalculated as part of this review to be 0.8 units, based on an effluent pH range of 6.0 to 9.0, a receiving water pH of 7.9, a maximum effluent alkalinity of 2.6 meq/l, a receiving water alkalinity of 2.3 meq/l, a receiving water temperature of 22° C, an effluent temperature of 20° C, a receiving water salinity of 31.9 ppt, and a minimum initial dilution of 26.5:1. The calculated pH following initial dilution ranged from 7.1 to 7.9.

6. *Does (will) the modified discharge comply with applicable water quality standards for:*

- *Dissolved oxygen?*
- *Suspended solids or surrogate standards?*
- *pH?*

The proposed discharge should comply with applicable state standards for dissolved oxygen. The minimum dissolved oxygen concentration following initial dilution is calculated to be 6.6 mg/l. The Massachusetts minimum standard is 6.0 mg/l. Dissolved oxygen depressions from farfield BOD exertion, steady-state sediment oxygen demand, and abrupt resuspension of sediments are predicted to be 0.01, 0.06, and 0.11 mg/l, respectively. Therefore, even under the unlikely occurrence of all these conditions simultaneously, the minimum dissolved oxygen concentration would not fall below 6.4 mg/l.

The maximum increase in suspended solids concentration resulting from the modified discharge is 1.9 mg/l. Massachusetts has no quantitative standard for suspended solids, but does have a provision that color, turbidity, or suspended solids "shall not be in concentrations or combinations that would exceed the recommended limits on the most sensitive receiving water use." The proposed suspended solids discharge should not exceed those limits.

The applicant reports that the lowest pH in the vicinity of the discharge during August, September, and October is 7.9. Discharging an effluent with pH 6.0 and the other properties given in Part III.B.5 will lower the natural pH more than 0.2 units (namely 0.8 units). However, more complete data on the annual range of pH in the New Bedford Harbor (Ellis et al., 1977) indicate a pH range from 6.6 to 10.1 can be expected. Discharging effluent with pH of 6.0 into a receiving water with pH 6.6 lowers the pH of the mixture to 6.46, a depression of 0.14 pH units below the lower limit of the natural range. This depression is less than the Massachusetts limit of 0.2 units maximum change in pH from the naturally-occurring range.

> 7. *Provide the determination required by 40 CFR 125.60(b)(2) or, if the determination has not yet been received, a copy of a letter to the appropriate agency(s) requesting the required determination.*

The applicant requested determination of compliance with Massachusetts water quality standards in a letter to the Division of Water Pollution Control dated December 2, 1983. A copy of this letter is included in the revised application. A reply was not available for comment at the time of this review (Ledger, B., 8 March 1984, personal communication).

C. Impact on Public Water Supplies [40 CFR 125.61(b)]

1. *Is there a planned or existing public water supply (desalinization facility) intake in the vicinity of the current or modified discharge?*

The applicant states that there are no desalinization facilities in the vicinity of the existing or proposed discharge, and that none are planned. This was confirmed by U.S. EPA, Region I (Manfredonia, R., 8 March 1984, personal communication).

D. Biological Impact of Discharge [40 CFR 125.61(c)]

1. *Does (will) a balanced indigenous population of shellfish, fish, and wildlife exist:*

   - *Immediately beyond the ZID of the current and modified discharge(s)?*
   - *In all other areas beyond the ZID where marine life is actually or potentially affected by the current and modified discharge(s)?*

Phytoplankton

The applicant indicates that the population of phytoplankton in the vicinity of the existing discharge is characteristic of a natural, indigenous community and is not adversely affected by the existing discharge. This conclusion is based on the inconsistency of differences in, presumably, phytoplankton abundance and community characteristics between stations located near the existing discharge and at control locations. Differences in phytoplankton abundance and community structure among the various sampling locations may be attributable to nutrient enrichment from other sources as well as from the existing discharge, and to clinal variations that may occur along an inshore-offshore gradient. These conclusions are, for the most part, appropriate. However, it would also be appropriate to conclude that the sporadically abundant and temporally persistent population of blue-green algae in the vicinity of the existing discharge indicates that the area is atypical in comparison with similar nearby areas such as Block Island Sound and Narragansett Bay.

Benthic Infauna

The applicant indicates that a balanced, indigenous population (BIP) of benthic invertebrates does not exist immediately beyond the ZID of the existing discharge. In Section II.C.1, the applicant concludes that "It appears likely that anthropogenic disturbances in the area adjacent to the New Bedford outfall contribute to determining the constituents of the benthos." These conclusions are supported by the following evidence from the 1983 field survey:

- Mean total infaunal abundance at Station 3 immediately beyond the existing ZID is significantly higher than that of the control site, Station 16.

- Population abundances of the opportunistic, pollution-tolerant species Capitella capitata, Streblospio benedicti, Polydora ligni, and Mediomastus ambiseta are significantly elevated just beyond the existing ZID in comparison with corresponding population abundances at the control site.

- Based on numerical classification and nodal analysis of community structure, infaunal communities immediately beyond the existing ZID are similar to those within the existing ZID, but dissimilar to communities at sites 0.5-1.0 km (0.3-0.6 mi) from the existing discharge and at the control site.

- Species Group F, consisting mainly of opportunistic taxa, was well represented only at stations within and immediately beyond the existing ZID.

These results corroborate the findings of a limited benthic survey conducted by the applicant in 1979. Because the earlier survey used methods different from those of the 1983 survey, the results of the two sampling efforts are not comparable. Despite the lack of data comparability, the applicant concludes that "a definite improvement in conditions has occurred since 1979," because of an apparent increase in numbers of organisms and species diversity at sites near the outfall from 1979 to 1983. However, the applicant has not demonstrated that the apparent changes in infaunal communities near the outfall are due to factors other than increased sampling effort and better taxonomic identification during the 1983 survey.

In Section III.D.1, the applicant does not discuss the presence or absence of a BIP of benthic infauna in all other areas beyond the existing ZID where marine life is actually or potentially affected by the existing discharge. Nevertheless, it is clear from data presented in the application and in Section II.C.1 above that infaunal communities up to at least 1.0 km (0.6 mi) north and 0.5 km (0.3 mi) southwest of the existing discharge exhibit major alterations in species richness, total infaunal abundance, and community structure compared with control conditions. Gradients of increasing species richness and increasing total infaunal abundance are related to distance from the existing discharge. Benthic conditions at Station 6 located 1.0 km (0.6 mi) north of the existing discharge and at Station 9 located 0.5 km (0.3 mi) southwest of the existing discharge are characteristic of a transition zone between severe adverse impacts at the existing discharge and control conditions. Because the applicant did not sample at sites located further than 1.0 km (0.6 mi) from the existing discharge, the spatial extent of impacts attributable to the existing discharge cannot be determined entirely. However, the high species richness and slight alteration of community structure at Station 10 indicate that effects of the discharge on infaunal communities at locations 1.0 km (0.6 mi) or more southwest of the existing discharge site are probably minor.

The applicant predicts that relocation of the discharge should result in elimination of impacts to the benthic communities within and beyond the existing ZID. This prediction is based on a comparison of calculated ambient sediment deposition rates with expected mass deposition rates for sewage particles discharged from the proposed outfall. However, the applicant does not compare predicted (or measured) mass deposition rates for the existing discharge with those of the proposed discharge or with ambient mass deposition rates.

The first method used by the applicant to estimate ambient sedimentation rates is based on conversion of available data on mass accumulation rates to a range of mass deposition rates. The applicant takes values of 1-3 mm/yr for the range of sediment accumulation rates in Buzzards Bay from Summerhayes et al. (1977). This appears to be a reasonable range of values. However, the applicant then uses a percent solids value of 6 percent, based on the expected solids content of settled sewage, to calculate a mass deposition rate. Since an ambient deposition rate is being calculated, the applicant should have used a higher solids content, which is characteristic of natural submarine sediments (e.g., solids content of 40-65 percent). Based on the applicant's general approach, recalculation of mass deposition rate using 1-3 mm/yr and 50 percent solids content gives a range of values from 726 to 2,178 g m^{-2} yr^{-1}.

In the second method used by the applicant, estimates of deposition rates are calculated from steady state sediment oxygen demand. The applicant's calculations resulted in mass deposition rate estimates of 150-791 g m^{-2} yr^{-1}. The two highest values within this range were obtained from an unspecified site near Woods Hole and from a site adjacent to the Woods Hole sewage outfall. Use of the two highest values for estimates of ambient sedimentation rates at the proposed discharge site is inappropriate. First, the area near the Woods Hole outfall is perturbed by sewage inputs (Nichols 1977). Therefore, deposition rates for organic particles are probably elevated above natural levels due to anthropogenic sources. Second, the area near Woods Hole is a small enclosed bay, which is expected to have higher sedimentation rates than offshore areas of Buzzards Bay (e.g., proposed New Bedford outfall discharge site). Since the other two values for mass deposition rate were based on sediment oxygen demand data from Stations 13 and 17 (proposed discharge site and its control site, respectively), they are herein considered more accurate estimates of ambient sedimentation rates. Thus, acceptable estimates based on the applicant's second method are 150 and 212 g m^{-2} yr^{-1}. Since these values represent organic deposition only, they are not directly comparable to those calculated by the first method, which incorporates total (organic plus inorganic) deposition. Assuming an organic content of 10 percent, total mass deposition rates based on the first method of calculation convert to about 70-220 g m^{-2} yr^{-1} for organic mass deposition rate.

The applicant's final conclusion is that ambient organic sedimentation rates are about 100-600 g m^{-2} yr^{-1} and that the proposed discharge will increase the deposition rate by about 14-85 percent of the present natural rate. Based on the discussion above, the estimated range of ambient sedimentation rates is about 70-220 g m^{-2} yr^{-1}. Using the applicant's predicted organic deposition rate of 85 g m^{-2} yr^{-1} over an area of 1.0 km^2 (0.4 mi^2) (see above, Section III.A.4) and an ambient range of 70-220 g m^{-2} yr^{-1}, the proposed discharge will account for a 40-120 percent increase in organic deposition rates. Use of a lower suspended solids deposition rate (41.9 g m^{-2} yr^{-1}) calculated for the proposed discharge as part of this review (see above, Section III.A.4) would yield a 20-60 percent increase in organic deposition rates over an area of 6 km^2 (2.3 mi^2).

As part of this review, the deposition rate for organic particles discharged from the existing outfall was calculated for comparison with the corresponding parameter for the proposed discharge. Using the modified version of the sediment deposition model described in Tetra Tech (1982b), the organic deposition rate for the existing discharge is 762 g m^{-2} yr^{-1} over an area of 0.5 km^2 (0.2 mi^2). Compared with the corresponding deposition rate of 41.9 g m^{-2} yr^{-1} over an area of 6.0 km^2 (2.3 mi^2) for the proposed discharge (see above, Section III.A.4), the results indicate a much greater potential impact for the existing discharge than for the proposed discharge.

In conclusion, the applicant's estimate of increased organic deposition due to the proposed discharge (14-85 percent increase over ambient rate) appears reasonable, although a conservative estimate of impact calculated as part of this review suggests that sedimentation rates could be increased up to 120 percent. Increased sewage solids deposition rates that are less than ambient sedimentation rates can result in adverse impacts on benthic fauna, especially if effects of toxic substances associated with the sewage particles are significant. The impact of the proposed discharge on benthic infauna is expected to be less than that of the existing discharge because: 1) the mass emission rate of suspended solids for the proposed discharge [5,110 kg/day (11,266 lb/day) by 1989] will be substantially less than that of the existing discharge [9,325 kg/day (20,558 lb/day)], 2) water currents at the proposed discharge site are stronger than those at the existing discharge site, leading to more efficient dispersion of effluent, 3) the predicted organic deposition rate for sewage particles discharged from the proposed outfall is much less than that calculated for the existing discharge, and 4) improvements in treatment and an increase in initial dilution should reduce potential toxic effects. Mearns and Word (1982) have demonstrated correlations between solids mass emission rates and the areal extent of benthic community alterations resulting from sewage discharges. Unfortunately, their data were obtained from large sewage discharges in southern California, and cannot be extrapolated directly to the New Bedford area. Therefore, the degree of reduction in adverse impacts at the proposed discharge site compared with the existing discharge area cannot be precisely predicted based on the available information.

Fishes and Macroinvertebrates

The applicant indicates that an undisturbed community of fishes appears to exist in the vicinity of the existing discharge. In the present survey, as in the 1979 survey, scup were the dominant species collected. Densities of scup were greater near the discharge than elsewhere in the sampling area. The applicant does not find this to be an unusual or adverse impact because of the schooling and feeding behavior of scup. Scup are a strongly-schooling bottom fish that feed principally on shrimp (Crangon sp.), amphipods, young squid, and other epifaunal invertebrates (Bigelow and Schroeder 1953; Oviatt and Nixon 1973). Densities of flatfish species also appeared to be greater near the existing discharge than in other areas of the outer harbor and Buzzards Bay (Section II.C.1 of this review). There are, however, no apparent associations of density of bottom-feeding fishes with total density of infaunal invertebrates. However, differences in abundance of specific invertebrate groups that are affected by the existing discharge may play a role in the apparent distribution and abundance of bottom-feeding fishes because of their relative importance as prey (Pearson 1976; Rhodes et al., 1978; Virnstein 1977; Allen 1975; Kleppel et al., 1980; Manzanilla and Cross 1982). Therefore, it is possible that observed impacts of the existing discharge on abundances of opportunistic, pollution tolerant species of infaunal invertebrates within and just beyond the ZID may indirectly affect the abundance of bottom-feeding fishes that prey upon them.

2. *Have distinctive habitats of limited distribution been impacted adversely by the current discharge and will such habitats be impacted adversely by the modified discharge?*

There are no known distinctive habitats of limited distribution in areas potentially impacted by the existing and proposed discharges (see Section II.C.2 above).

3. *Have commercial or recreational fisheries been impacted adversely by the current discharge (e.g., warnings, restrictions, closures, or mass mortalities) or will they be impacted adversely by the modified discharge?*

The applicant states that restrictions have been placed on harvesting of fish and shellfish from New Bedford Harbor and adjacent areas of Buzzards Bay because of contamination by PCBs and coliform bacteria.

Areas closed because of contamination by PCBs were established in 1979 by the Massachusetts Department of Public Health, and were discussed by Tetra Tech (1981). The outfall lies within Area II (Figure 9), which is closed to harvest of bottom-feeding fishes and lobsters because of PCB contamination. As described by Tetra Tech (1981), part of Area II had been closed to harvest of hardshell clams since 1971 because of contamination by coliform bacteria. According to the applicant, a substantial portion of this area has recently been reopened to harvest of hardshell clams (see applicant's Figure IC10). The applicant gives no indication of the basis of the revised boundary. However, comparison of the old and new boundaries shows that substantial areas have also been closed to clamming as a result of the revision (Figure 10). Also, the existing discharge is located in the center of the newly-closed clamming area (Figure 10). The apparent reason for redefining clamming boundaries is that formerly-closed areas along the western shore of Clarks Cove and Sconticut Neck, which are over 2.0 km (1.24 mi) from the existing discharge, were opened to clamming, while formerly open areas, which are less than 1.5 km (0.93 mi) from the discharge, were closed to clamming.

Shellfish closures in the area of Clarks Cove and the existing outfall have been further revised since preparation of the revised 301(h) application (Hickey, M., 14 March 1984, personal communication). A new closure, which covers a larger area, became effective on November 28, 1983 (Figure 10). The new closure is based on poor water quality in the area (i.e., high concentrations of fecal coliform and total coliform bacteria in the water). Sources of bacterial contamination are a number of outfalls and combined sewer overflows in Clarks Cove. The New Bedford discharge contributes to the contamination during periods of high runoff and favorable tidal conditions. All bivalves except for bay scallops are affected by the closure. Scallops are exempt because only the adductor muscle is eaten and is, presumably, unaffected by bacterial contamination. The revised boundary for the taking of bivalves other than scallops does not affect other prohibitions within Area II (Figure 9) since they are based on contamination of bottom-feeding fishes and lobsters by PCBs.

The applicant predicts that the location of the proposed discharge beyond Area III (Figure 9) will not result in any changes to the current PCB-derived restrictions, nor prevent reopening of Area III to harvest of lobsters in the future. The basis for the applicant's reasoning is that PCBs were not identified in three recent samples of the waste stream taken in June, August, and October of 1983. Detection limits were 10 ppb for one of the samples and 1.0 ppb for the remaining sample. It should be noted, however, that while it appears that effluent PCB concentrations have been reduced, conclusive data on the degree of PCB contaminant reduction are not yet available (see Section III.H.2 below).

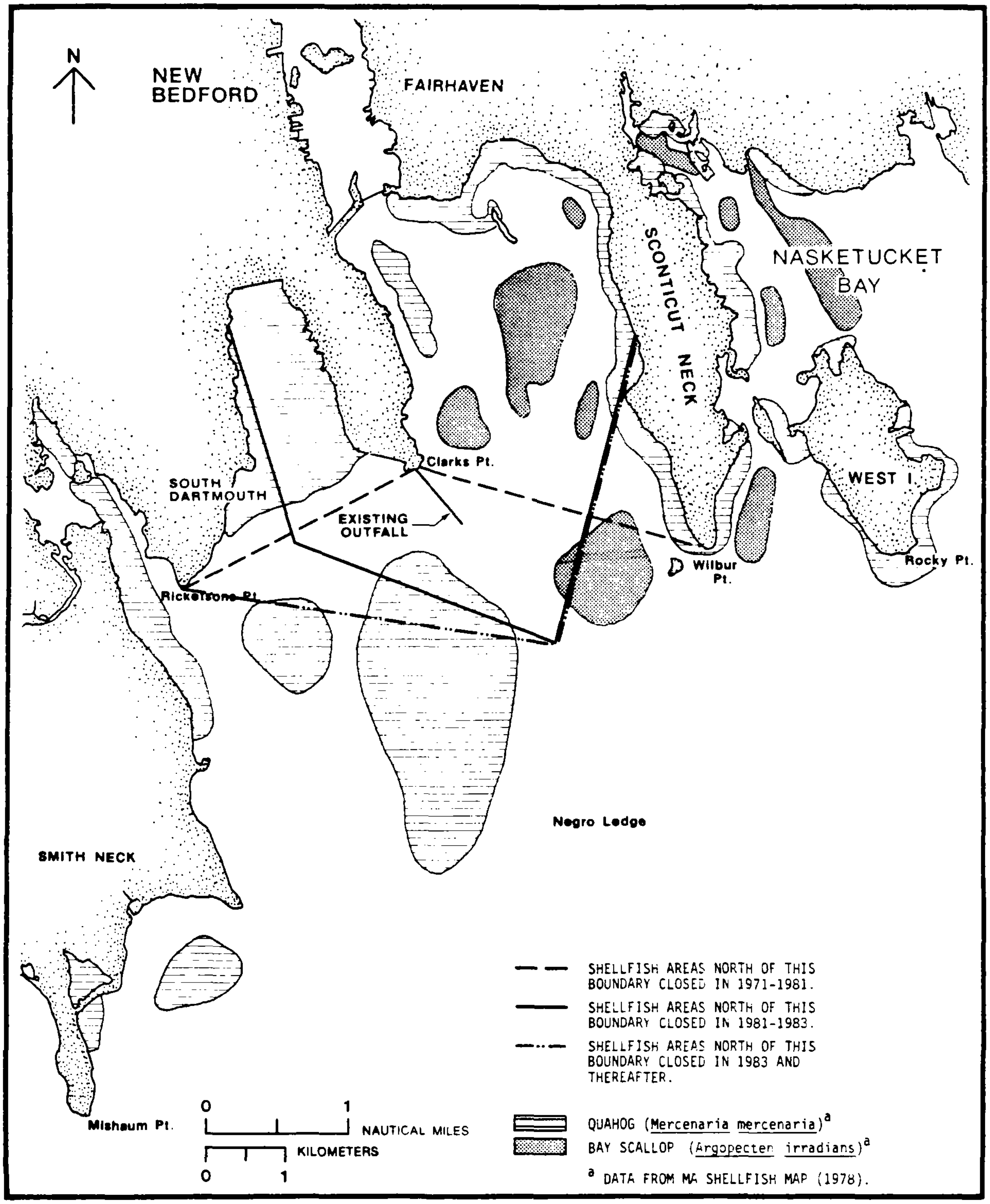


Figure 10. Location of shellfish beds and areas closed due to coliform bacteria contamination in New Bedford Harbor.

Likewise, the applicant points out that loadings of coliform bacteria in the vicinity of the existing outfall originate from a number of sources in addition to the existing discharge. Other sources include combined sewer overflows, dry-weather overflows, and stormwater runoffs. The applicant indicates that the location of the proposed discharge should not adversely affect coliform bacteria-related closure of hardshell clamming, but may have a mitigating effect on present clamming restrictions.

4. *Does the current or modified discharge cause the following within or beyond the ZID: [40 CFR 125.61(c)(3)]*

- *Mass mortality of fishes or invertebrates due to oxygen depletion, high concentrations of toxics or other conditions?*
- *An increased incidence of disease in marine organisms?*
- *An abnormal body burden of any toxic material in marine organisms?*
- *Any other extreme, adverse biological impacts?*

Mass Mortalities

The applicant indicates that mass mortalities of menhaden (Brevoortia tyrannus) occurred inside the hurricane barrier during the period 1976-1978, but that no such kills have occurred since 1979. Tetra Tech (1981) found that no specific cause could be associated with these mortalities of menhaden.

Disease

Tetra Tech (1981) concluded that the site of the existing discharge does not appear to be a disease epicenter for fishes. These findings are substantiated in the more recent study. No diseased fish were found in either the otter trawl or gill net catches during 1983. However, 10 menhaden captured in gill nets had ectoparasites. The type and extent of parasitism are not described by the applicant. The applicant also indicates that lobster collected from two Massachusetts Division of Marine Fisheries sampling stations were subjected to routine histopathological examination by personnel from the EPA's Environmental Research Laboratory. The sampling locations were about 1.0 km (0.62 mi) north and 2.6 km (1.62 mi) northeast of the existing discharge. Results of the examination indicated that the lobsters were in excellent health and relatively free of parasites (Yevich, P., 14 March 1984, personal communication).

Bioaccumulation

The applicant discusses several studies of toxic substances in marine biota, sediments, and treatment plant effluent, with emphasis on recent analyses of PCBs. According to the applicant and recent technical reviews (e.g., Weaver 1984), extensive PCB contamination of New Bedford Harbor and adjacent areas of Buzzards Bay has been documented. Although the major industrial sources of PCB contamination (Aerovox Corporation and Cornell-Dubilier Corporation) ceased direct discharge of PCBs in 1976, contaminated terrestrial waste sites and aquatic sediments remain a source of PCBs for uptake by biota. Further assessment of the extent of PCB contamination, prioritization of contaminated sites for remedial action, and initial cleanup activities are currently proceeding as part of the U.S. EPA Superfund program. Also, the applicant describes completed source-control work, including removal of PCB-contaminated sediments from sewer lines feeding into the New Bedford treatment plant.

PCBs--

The applicant presents data on PCB concentrations in fish and shellfish collected by the Massachusetts Division of Marine Fisheries from 1976 through 1983. Data collected before 1981 were reported originally by Kolek and Ceurvels (1981). Data collected after 1980 were taken from unpublished data files of the Massachusetts Division of Marine Fisheries. Details of sampling station locations, sample collection and processing methods, and analytical methods are not given by the applicant. However, Kolek and Ceurvels (1981) indicate that "only edible portions of each sample" were analyzed, using the procedure of the U.S. Food and Drug Administration (FDA) described in the Pesticide Analytical Manual, Volume 1, Section 212.13a.

Kolek and Ceurvels (1981) state that the analytical procedure has a "sensitivity" of less than 0.1 ppm, but the term "sensitivity" is not defined. Detection limits are also not provided. Since three different laboratories were involved in at least the analysis of the 1976-1980 samples, a laboratory intercomparison exercise was conducted. Kolek and Ceurvels (1981) state that the laboratories "split and analyzed six samples...The mean of all the samples was 5.0 with a standard error of 0.7." Units were not specified in this statement, but are assumed to be ppm (mg/wet kg) total PCBs. This indicates that the samples were relatively homogeneous with respect to PCB contamination, and that the laboratories reported reasonably similar results.

Station locations for PCB analyses presented by the applicant and by Kolek and Ceurvels (1981) are shown in Figure 11. Information on exact station locations and methods used for positioning stations were not given. Since various organisms were sampled, but not all species were collected from each site, the data for any one species are limited to a subset of those stations shown in Figure 11. The most complete data set exists for lobsters. The applicant presents data for all species in tabular form (Table IID1 of the revised application), but analyzes only the lobster data. Specific Arochlors analyzed for are not reported by either the applicant or by Kolek and Ceurvels (1981). Values reported by the applicant are assumed herein to be total PCBs unless stated otherwise.

Data on PCB concentrations in lobsters are available from eight stations in the general vicinity of the existing discharge and from five stations in the general vicinity of the proposed discharge (Figures 11 and 12). Annual averages of PCB concentrations as reported by the applicant are plotted in Figure 12, as well as the minimum and maximum values measured at each site for all years combined (from Table IID1 of the revised application). Direct comparisons of the data among sites are not possible because sampling times generally differed among stations. The potential for seasonal variation in contaminant concentrations in lobster tissue could therefore bias among-site comparisons based on data consisting of annual averages. Because of inconsistencies in sampling times among sites and because the sampling station closest to the existing outfall area was nearly 1.0 km

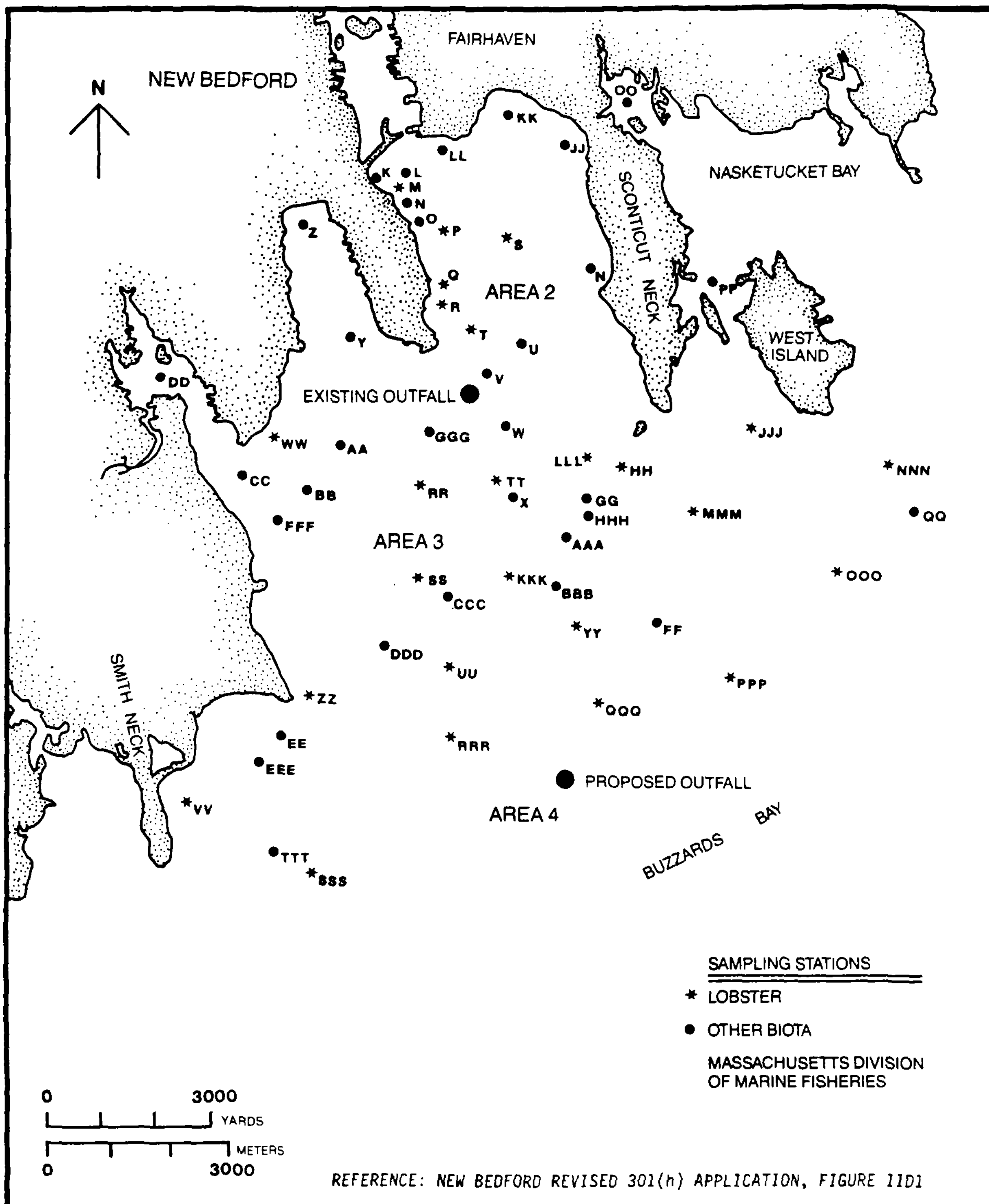
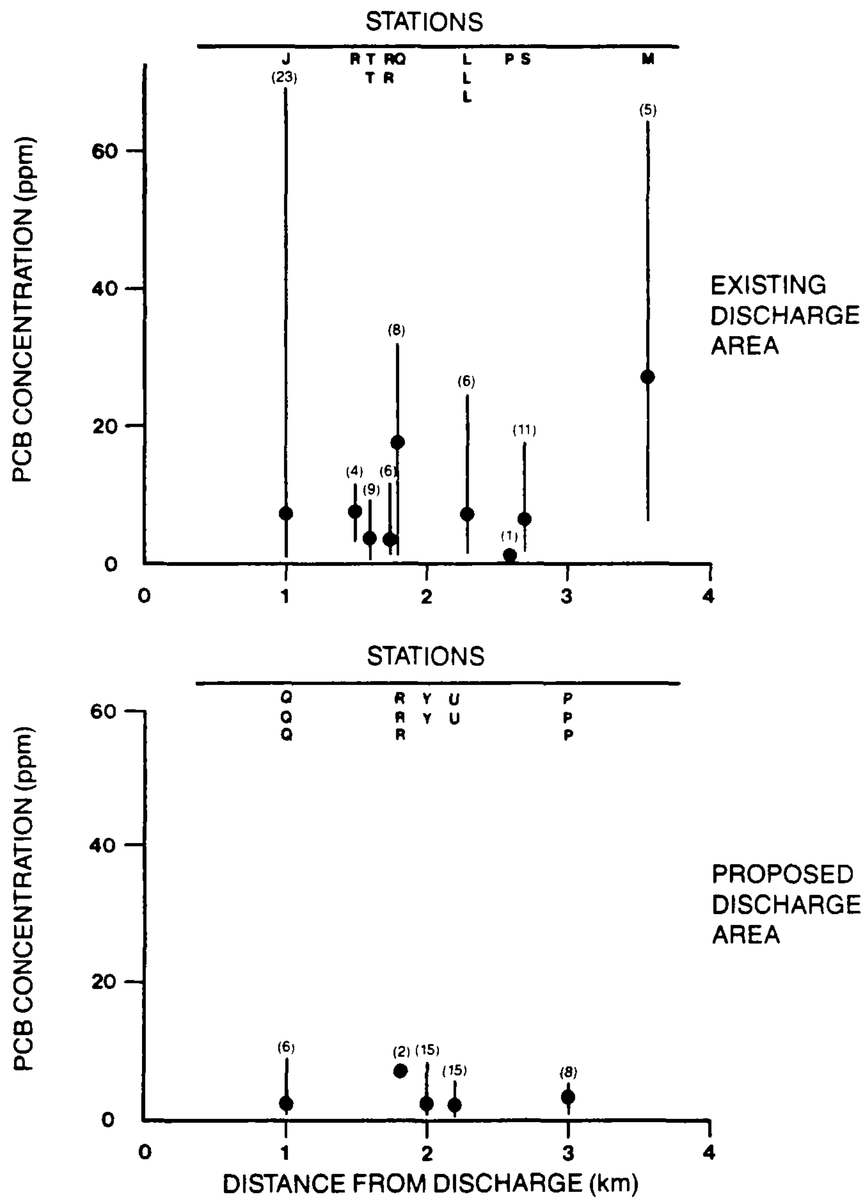


Figure 11. Sampling station locations for analyses of PCBs in biota.



NOTE: DISTANCES ARE APPROXIMATE. STATIONS WERE NOT ARRAYED ALONG LINEAR TRANSECTS (SEE FIGURE 10). NUMBERS IN PARENTHESES ARE NUMBERS OF MEASUREMENTS. DATA FROM ALL YEARS WERE COMBINED.

SOURCE: NEW BEDFORD REVISED 301(h) APPLICATION, TABLE IID1

Figure 12. Mean and range of PCB concentrations in muscle tissue of lobsters.

(0.6 mi) away, the data provided by the applicant cannot be used to determine whether the existing discharge causes an abnormal body burden of PCBs in lobsters. Nevertheless, it is clear that average PCB concentrations in lobsters are higher throughout the area near the existing discharge than they are in the vicinity of the proposed discharge (Figure 12). This trend is undoubtedly related to the overall gradient in PCB concentrations in biota from high values at stations in New Bedford Harbor to lower values in offshore areas of Buzzards Bay (cf. Table IID2 of the revised application).

The applicant states that "the body burden of PCB compounds in lobsters taken near the proposed outfall location is consistently below the FDA limit of 5 ppm" and that "the only notably high levels were measured at site RRR in 1980." These conclusions are based on annual averages of PCB concentrations in lobsters (Table IID4 of the revised application). However, inspection of Table IID1 of the revised application and Figure 12 reveals that maximum values measured at four of the five stations in the vicinity of the proposed discharge area exceeded the FDA limit of 5 ppm.

The applicant also presents data on PCB concentrations in sediments near the existing and proposed discharge sites. Data were collected at the existing discharge area during 1979 and 1981. The 1979 data were presented in the original New Bedford 301(h) application and reviewed by Tetra Tech (1981). The more recent sampling was conducted at 14 stations (Figure 13) by the Massachusetts Division of Water Pollution Control (unpublished data, as cited by the applicant). Information on exact station locations and station positioning methods is not provided. Based on the figure provided by the applicant, all stations appear to be located beyond the ZID of the existing discharge. Station XVIIc is located approximately 100 m (300 ft) from the existing outfall terminus. Stations XVIIa,b and XVIa,b,c are each located within 0.5 km (0.3 mi) of the existing discharge site. All other sampling stations in Figure 13 are located in New Bedford Harbor beyond the immediate influence of the existing discharge. Since PCB contamination occurs throughout the area, none of the stations can serve as an unstressed control.

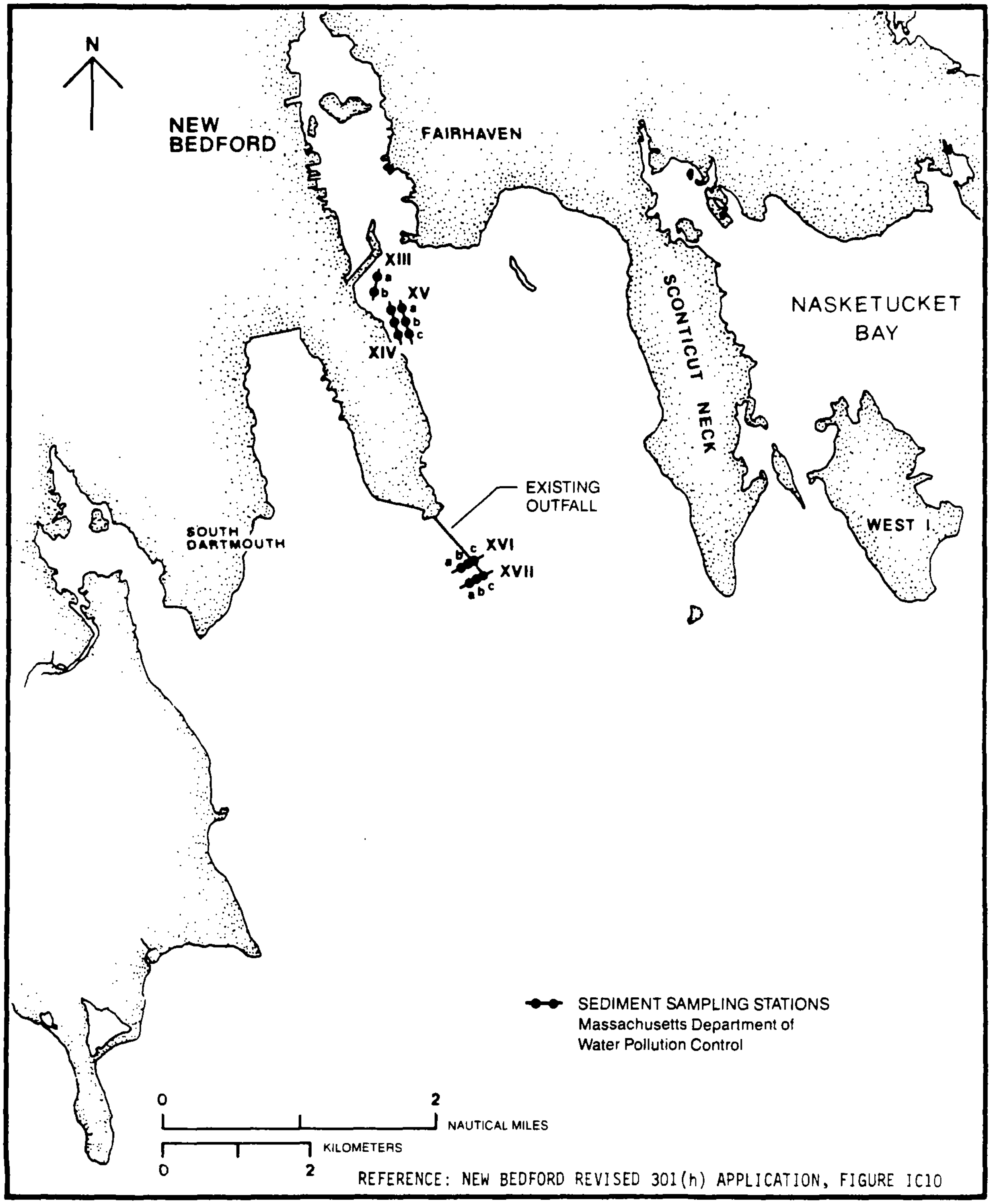


Figure 13. Sampling station locations for analyses of PCBs in sediments.

Samples of the sediment layer at a depth of 10 cm (4 in) were collected by the Massachusetts Division of Water Pollution Control using a winch-operated corer. Since details of the sampling and analytical methods are not provided, the quality of the data cannot be evaluated as part of this review. Also, it is unclear whether the sample was taken as a discrete layer at only the 10-cm (4-in) sediment depth or as a composite over the interval of 0-10 cm (0-4 in).

The applicant also indicates that sediments at the proposed discharge site (Station 13) and the control site (Station 17) were analyzed for all "PCB isomers" during October, 1983. Triplicate sediment samples were collected with a modified "0.53-m^2" (5.7-ft^2) Ponar grab sampler. It is assumed that the stated size of the sampler was a typographical error and that the actual size was 0.053 m^2 (0.57 ft^2). All samples were frozen and processed later according to acceptable methods, which are referenced by the applicant. Since the applicant does not indicate if a specific depth-layer of the sample was analyzed, it is assumed herein that the entire sample was processed and analyzed. Detection limits reportedly ranged from a reasonable level of 0.3 ppb to a relatively high level of 2.0 ppb.

Results of recent analyses of PCBs in sediment samples are shown in Table 10. Data that were reported in the original New Bedford application and evaluated by Tetra Tech (1981) are also included in the table. These results confirm that PCB contamination of sediments is widespread in the vicinity of the existing discharge. However, the spatial resolution of the sediment data is not sufficient to define the areal extent or relative contribution of PCB contamination caused by the existing discharge. PCBs have not been detected in sediments near the proposed discharge site (Table 10).

The applicant indicates that removal of PCB-contaminated sediments from sewer lines has probably resulted in reduced concentrations of PCBs in the plant effluent. For example, PCBs were not detected in composite samples of effluent collected on June 15-16 (dry-weather) and August 11-12, 1983 (wet-weather). Detection limits were 10 ppb and 1 ppb, respectively for the two sampling periods. At concentrations slightly less than 1 ppb

TABLE 10. CONCENTRATIONS OF PCBs IN SURFACE SEDIMENTS OF NEW BEDFORD HARBOR AND BUZZARDS BAY IN THE VICINITY OF THE EXISTING AND PROPOSED DISCHARGES

Survey	Station(s)	Location	PCBs (ppm)[a]	Reference
1981, Massachusetts Dept. of Water Pollution Control	XVIa,b,c XVIIa,b,c	Within 0.5 km (0.3 mi) of existing discharge	5.5-34.6	New Bedford revised 301(h) application Table IID5
	XIVa,b,c XVa,b,c	New Bedford Harbor	5.8-13.2	
	XIIIa,b	N of Cornell-Dubilier Corp.	29.2-30.5	
1983, Normandeau Associates	13	Proposed outfall site	ND[b]	New Bedford revised 301(h) application pp. I-115, II-41, and Table IC23
	17	Control, Buzzards Bay	ND[b]	
1979, Camp Dresser and McKee	S1	Within existing ZID	8.75[c]	New Bedford original 301(h) application Table XVII-15
	S2	Near existing ZID	27.0[c]	
	Control	Nasketucket Bay	ND[d]	
	S8,S9	Beyond proposed ZID	ND[d]	
1979, 1980 Massachusetts Dept. of Environmental Quality Engineering	23	Existing discharge site	15.6[e]	Tetra Tech (1981) Table 33
	1,1A,6	Acushnet R., N of Popes Is.	2.6-72.7[e]	
	10,14,18,19	Acushnet R., S of Popes Is.	ND-7.9[e]	
	22A	New Bedford Harbor	0.92-43.6[e]	

[a] Type of measurement (total PCBs or specific Arochlors; dry-weight or wet-weight basis) was not specified unless otherwise noted.

[b] Not detected at detection limits of 0.3-2.0 ppb, wet weight.

[c] Arochlor 1254, ppm dry weight.

[d] Not detected at detection limit of 2.0 ppb.

[e] Arochlor 1254.

in effluent, however, PCBs could exceed the 24-h aquatic-life criterion of 0.03 ppb after initial dilution (assuming a minimum initial dilution of 26.5:1, as calculated during this review). Also, existing estimates of sediment deposition are inadequate to determine whether effluent concentrations of PCBs less than 1 ppb could result in significant accumulation of PCBs in sediments at the proposed discharge site.

Metals--

The applicant indicates that surveys conducted for the 1979 application revealed higher concentrations of chromium, copper, nickel, and zinc in shellfish near the existing discharge site than in those from surrounding areas. Tetra Tech (1981) reviewed the 1979 data and concluded that bioaccumulation of metals appeared to be occurring near the existing discharge, but that survey methods and target species were not adequately described. The 1979 sediment data indicated a potential for substantial bioaccumulation of metals near the existing discharge (Tetra Tech 1981).

During the 1983 benthic survey, the applicant collected triplicate grab samples of sediments at the proposed discharge site (Station 13) and a control site (Station 17) for analysis of four trace metals: copper, chromium, zinc, and lead. The samples used for analyses of PCBs discussed earlier were the same as those used for analyses of metals. Sample collection, processing, and analytical methods used by the applicant followed U.S. EPA guidelines. Results of the sediment analyses indicated that concentrations of target metals at the proposed discharge site were similar to those at the control site. The mean concentrations (dry weight basis) at the proposed discharge site were 13.2 ppm for lead, 21.0 ppm for chromium, 38.0 ppm for copper, and 64.0 ppm for zinc. Concentrations at the control site were 15.3 ppm for lead, 23.3 ppm for chromium, 42.3 ppm for copper, and 71.7 ppm for zinc. The applicant notes that chromium and lead levels at the proposed discharge site and control were lower in 1983 than in 1979, while zinc concentrations were somewhat higher (see Table XVII-15 of the 1979 application for the earlier data). Concentrations of chromium, lead, and zinc at the proposed discharge site are generally indicative of unpolluted marine sediments (cf. Sherwood 1982). Concentrations of copper at the proposed discharge site are slightly higher than expected for clean estuarine sediments of the eastern U.S. For example, Sherwood (1982) found that copper concentrations in sediments from the relatively unpolluted Great Bay, New Jersey, ranged from 9.0 to 21 ppm, with a median of 9.2 ppm.

The applicant states that "Recent sampling of the wastestream has revealed that a substantial reduction in levels of metals has occurred." Data are not provided in Section III.D to support this statement. Moreover, the results of dry-weather and wet-weather effluent analyses presented in Table IIH1 of the revised application suggest that little or no change in effluent concentrations of most metals has occurred from 1979 to 1983. Data provided by the applicant are insufficient for a conclusive analysis of temporal trends in effluent concentrations of metals.

The applicant states that copper is the only metal that is expected to exceed water quality criteria following initial dilution of the proposed discharge. However, other metals such as mercury and nickel may also exceed water quality criteria following initial dilution if their concentration in the effluent approaches the stated quantitation limit for the 1983 analyses (see below, Section III.H.2).

In conclusion, the available data suggest that the existing discharge contributes to abnormally high body burdens of metals and PCBs in marine organisms. The contribution of the existing discharge cannot be quantified based on present data. Recent analyses indicate that the concentrations of PCBs in the effluent have decreased since 1979, but that concentrations of toxic metals (e.g., chromium, copper, nickel, and cadmium) have probably remained about the same. Since the data are limited and many metal concentrations are reported by the applicant as quantitation limits, temporal trends cannot be defined reliably. The available information does not provide evidence to demonstrate that the proposed discharge will not cause an abnormal body burden of any toxic substance in marine organisms.

5. For discharge into saline estuarine waters: [40 CFR 125.61(c)(4)]

- *Does or will the current or modified discharge cause substantial differences in the benthic population within the ZID and beyond the ZID?*
- *Does or will the current or modified discharge interfere with migratory pathways within the ZID?*
- *Does or will the current or modified discharge result in bioaccumulation of toxic pollutants or pesticides at levels which exert adverse effects on the biota within the ZID?*

Benthic Infauna

The applicant states that "The current discharge has caused a difference in the types of benthic species within and beyond the ZID...." The applicant further indicates that opportunistic species such as Capitella capitata, Mediomastus ambiseta, and Streblospio benedicti are dominant within the ZID. Based on a review of data provided by the applicant, these pollution-tolerant species are rare in benthic communities inhabiting the control site (Figure 7 above). Species composition and community structure of benthic infauna within and near the existing ZID are greatly modified relative to those beyond the existing ZID. Changes in communities within and near the existing ZID generally correspond to expectations based on conceptual models relating organic enrichment to numerical abundance and community structure (e.g., Figure 8 above and Pearson and Rosenberg 1978).

As noted by the applicant, mean species richness within the existing ZID was not statistically different from that found at the control site, i.e., 41 (SD=7.7) and 51 (SD=4.4) species per 0.1 m^2 (1.1 ft^2), respectively. Based on current models of sewage pollution (Figure 8), the species richness of modified communities within the existing ZID would be expected to be lower than that of the control site. One possible explanation for this result is that a true difference does exist between species richness within the existing ZID and the control, but that the applicant's sampling program was not sensitive enough to detect the relatively small (20 percent) difference in means. Sandy habitats beyond the existing ZID generally supported a greater number of species than did those within the existing ZID or at the control site. For example, the mean number of species per replicate was 86 (SD=7.0) at Station 10 and 71.0 (SD=9.1) at Station 15. If species richness within the existing ZID is really not different from that of the control, as the applicant's data suggest, then the existing discharge has a major effect on community structure without affecting the number of species in the community. This unusual pattern could result from a variation of the functional relationship between species richness and organic enrichment. In the New Bedford system, for example, the peak of the species richness vs. enrichment curve may be displaced toward higher sewage loading (i.e., toward the left of the diagramatic model in Figure 8). Then, stations beyond the existing ZID, which experience moderate enrichment, would display the highest species richness, whereas the control (i.e., toward the right in Figure 8) and within-ZID sites (i.e., toward the left in the figure) would have relatively low species richness values, which could be nearly equivalent to one another.

The applicant predicts that the proposed discharge will result in reduced impacts on benthic populations within and beyond the proposed ZID compared to conditions at the existing discharge site. The applicant indicates that: 1) stronger currents at the proposed discharge site and the new outfall-diffuser system will provide wider dispersal of effluent, reducing impacts due to settling of sewage solids; 2) removal of suspended solids and metals will be enhanced by treatment improvements; and 3) pesticides and PCBs have been reduced to below detectable concentrations in the effluent, and copper concentrations will be controlled through a pretreatment program. Based on the discussion in previous sections (see above, Sections III.D.1 and III.D.4), the applicant's conclusion that outfall relocation and treatment improvements will result in less impacts at the proposed discharge site than at the existing discharge site appears reasonable.

In response to Question III.D.5, the applicant does not indicate whether the proposed discharge will cause substantial differences between benthic communities within the proposed ZID and those beyond the proposed ZID. In Section III.D.1, the applicant predicts that "a BIP will continue to exist within and beyond the ZID of the improved outfall..." This prediction is based primarily on limited, steady state projections of seabed accumulation of organic solids discharged from the proposed outfall. The applicant's model predicts a total organic deposition rate of 85.4 g m^{-2} yr^{-1} over an area of 1.0 km^2 (0.4 mi^2), accounting for an increase of up to 120 percent over ambient organic deposition rates (see above, Section III.D.1). The applicant supplies no quantitative information, however, that relates the magnitude of benthic community effects to elevations in sediment deposition rates above ambient levels. Although the predicted deposition rate for the proposed discharge is small relative to the existing discharge, the effects of the proposed discharge could be substantial within and beyond the proposed ZID. Note that the predicted organic deposition rate is averaged over an area 60 times the size of the ZID. Since the deposition rate is expected to decrease as a function of distance from the center of the zone of maximum deposition, discharge-related deposition rates within the proposed ZID could be substantially greater than 120 percent above ambient deposition rates (assuming the center of the true ZID corresponds to the center of the zone of maximum anthropogenic deposition, but does not necessarily coincide with the center of the diffuser). Thus, effects of the proposed discharge on benthic communities within the ZID could be significant.

Migratory Pathways Within the ZID

According to the applicant, pathways of migration have not been documented for New Bedford Harbor or Buzzards Bay. However, the proposed discharge is not anticipated to interfere with migratory pathways because of the small size of the ZID [625.2 x 26.6 m (2,051 x 87.3 ft)] relative to the distance between Round Hill Point and Wilbur Point [7.8 km (4.8 mi)]. Therefore, the applicant concludes that the ZID will affect only an insignificant area within the outer harbor. This is a reasonable conclusion with respect to the proposed discharge site. The applicant provides no indication of the impact of the existing discharge on migratory pathways. However, given the proximity of the existing discharge to shore [0.9 km (0.6 mi)] and the size of the ZID [a circle with a radius of 9 m (29.5 ft)] the extent of impacts on migratory pathways, if any, at the existing discharge site would also be small.

Bioaccumulation Effects

The applicant summarizes data presented in previous sections of the revised application, which demonstrate that marine organisms, especially lobsters, throughout New Bedford Harbor accumulate large amounts of PCBs in their tissues. However, the applicant does not discuss the potential for the PCB bioaccumulation observed near the existing discharge to cause adverse effects on biota within the ZID. Direct studies of PCB bioaccumulation and its effects have not been conducted within the ZID at either the existing or the proposed discharge site.

Available data suggest that PCB concentrations in some lobsters beyond the ZID of the existing discharge are high enough to cause adverse effects (Figure 12), but obvious evidence of toxic effects (e.g., external tumors, histopathological abnormalities) was not found in studies performed by the Massachusetts Division of Marine Fisheries. Obvious external abnormalities were also not found in fishes collected in the vicinity of the existing discharge.

The applicant indicates that the proposed discharge will not cause bioaccumulation of PCBs, pesticides, or toxic metals at levels responsible for adverse effects on biota. Available data do not permit a quantitative prediction of bioaccumulation effects within the ZID at the proposed discharge site.

6. *For improved discharges, will the proposed improved discharge(s) comply with the requirements of 40 CFR 125.61(a) through 125.61(d)? [40 CFR 125.61(e)]*

Phytoplankton

The applicant indicates that a natural community of marine organisms will exist within and beyond the ZID of the improved discharge, but does not specifically discuss its impact on the phytoplankton community. Results of the phytoplankton survey conducted in the vicinity of the existing discharge corroborate those of an earlier survey (see original application and evaluation thereof by Tetra Tech 1981). Phytoplankton in the nearshore area of the outer New Bedford harbor are indicative of organic enrichment, but it is not likely that they have adversely affected other members of the marine community. However, impact of the proposed discharge on the phytoplankton community is likely to be minimal because of increased depth of the discharge and consequent dilution of introduced nutrients. Also, the improved discharge is located from 4.2 to 6.7 km (2.6 to 4.1 mi) from shore, and will therefore be removed from other nearshore sources of nutrients that may contribute to increased phytoplankton productivity and the prevalence of pollution tolerant species.

Benthic Infauna

The applicant states that "a balanced indigenous population will exist both within and beyond the zone of initial dilution." As discussed in previous sections (see above, Sections III.D.1 and III.D.5), the applicant's prediction of the maintenance of a BIP within and immediately beyond the ZID is based on limited estimates of mass deposition rates over an area of 1 km^2 (0.4 mi^2) near the proposed discharge site. Organic deposition rates within and immediately beyond the proposed ZID could be substantially greater than 120 percent over ambient deposition rates. Thus, the benthic communities within and immediately beyond the proposed ZID may differ from indigenous assemblages beyond the influence of the proposed discharge.

Movement of the discharge to the proposed offshore location should allow some recovery of benthic communities at the existing discharge site. However, it should be recognized that biological communities at the existing discharge site may not recover fully in the absence of the discharge. The degree of recovery will depend on the magnitudes of continuing pollutant inputs from sources other than the applicant's discharge (e.g., combined sewer overflows, storm drainage, industrial discharges to New Bedford Harbor). The rate of recovery will depend partly on the influence of historical pollution of sediments, especially by toxic substances such as metals and PCBs.

Fishes and Macroinvertebrates

The applicant predicts that the fish community as well as migratory pathways will not be adversely affected by the improved discharge. The applicant's conclusion is based on improved effluent treatment, diffuser design and location of discharge, and the additional assumption that a natural undisturbed community of fishes exists near the existing discharge site. However, as discussed in Sections II.C.1 and III.D.1 above, this assumption may not be appropriate in the case of scup and flatfishes. The applicant's predictions of future biological conditions at the proposed discharge site following relocation of the outfall should focus on comparisons with other discharges that are similar to the relocated discharge (Tetra Tech 1982b). Such comparisons are not made by the applicant.

Restrictions on the harvest of fish and shellfish because of PCB contamination in the vicinity of the existing discharge have been described by Tetra Tech (1981). The existing outfall lies within the outer harbor (Area II; Figure 9), which is closed to the harvest of bottom-feeding fishes and lobsters because of PCB contamination. According to Weaver (1984), 5 of 14 species of fish sampled between 1978 and 1980 exceeded the FDA criterion for PCB concentrations in fish flesh (5 mg/kg wet wt). Affected species were bottom-feeding fishes: American eel (*Anguilla rostrata*), cunner, summer flounder, windowpane flounder, and winter flounder. All five species were present in the MDMF trawl collections near the existing discharge. Four of the affected species, the three flounder species and cunner, were present in MDMF collections near the proposed discharge site. Therefore, it is reasonable to suppose that these species may be affected by PCB contaminaton at the modified discharge site in proportion to the extent they are presently being affected by PCB contamination contributed by the existing discharge.

The proposed (i.e., improved) discharge site lies about 1.0 km (0.62 mi) outside of closure area III (Figure 9), which is closed to harvest of lobsters. The applicant indicates that restrictions on lobstering in the vicinity of the proposed discharge "may be lifted in the near future" presumably because of decreased levels of contamination, but that "movement of the discharge to the proposed location will alter the lifting of this restriction based on results of current testing." Further details of the anticipated effects of the proposed discharge on these restrictions are not discussed by the applicant. Presumably, the applicant is referring to testing of the effluent for PCBs. Given the lowest detection limit reported by the applicant (1.0 ppb), the concentration of PCBs in the effluent could potentially exceed U.S. EPA criteria following initial dilution (see Section III.H.2 below). It may be necessary for the applicant to demonstrate still lower concentrations of PCBs in the effluent before it will be possible to consider the potential for adverse effects of PCB contamination to be negligible.

7. *For altered discharge(s), will the altered discharge(s) comply with the 40 CFR 125.61(a) through 125.61(d)? [40 CFR 125.61(e)]*

This question is not applicable, since the New Bedford application is not for an altered discharge.

8. *If your current discharge is to stressed waters, does or will your current or modified discharge: [40 CFR 125.61(f)]*

- *Contribute to, increase, or perpetuate such stressed condition?*
- *Contribute to further degradation of the biota or water quality if the level of human perturbation from other sources increases?*
- *Retard the recovery of the biota or water quality if human perturbation from other sources decreases?*

The applicant considers the receiving environment for the existing discharge to be stressed as a result of contamination by coliform bacteria and PCBs. However, the improved discharge will be into waters outside of the stressed area. Therefore, to whatever extent the existing discharge is contributing to nutrient enrichment, and bacterial and PCB contamination, its relocation to an unstressed area should have a mitigating effect on the stressed area. Relocation of the outfall to the proposed discharge site is not expected to affect shellfish closures in the area of the existing discharge (Viscardi, D., 14 March 1984, personal communication), due to the numerous sources of contamination in addition to that of the existing discharge. According to the applicant, the existing discharge accounts for a minor portion of the coliform bacteria contamination. Combined sewer overflows, dry-weather overflows, and storm drainage also represent sources of coliform bacteria, the total input of which is three orders of magnitude greater than the coliform bacteria influx from the existing discharge. The proposed treatment improvements and outfall modifications are expected to result in a small decrease in coliform bacteria loading at the existing discharge site. The modified discharge is not expected to cause a coliform contamination problem (see below, Section III.E.2).

The applicant indicates that the existing discharge has contributed to PCB contamination in sediments and biota, but that recent cleanup operations have reduced PCB concentrations in effluents to "non-detectable limits." As discussed in Section III.D.4, the detection limits for 1983 effluent analyses were 10 ppb and 1 ppb for dry-weather and wet-weather samples, respectively. At concentrations less than 1 ppb in effluent, PCB could exceed the 24-h aquatic-life criterion of 0.03 ppb after initial dilution (see Section III.H.2 below). Nevertheless, the proposed discharge is not expected to cause substantial bioaccumulation of PCB or adverse effects resulting from such bioaccumulation. The present receiving environment at the proposed discharge site does not appear to be stressed, as indicated by sediment contamination data and characteristics of the benthic infaunal community. The proposed discharge could contribute to development of a stressed condition in offshore areas of Buzzards Bay if the level of human perturbation from other sources increased substantially.

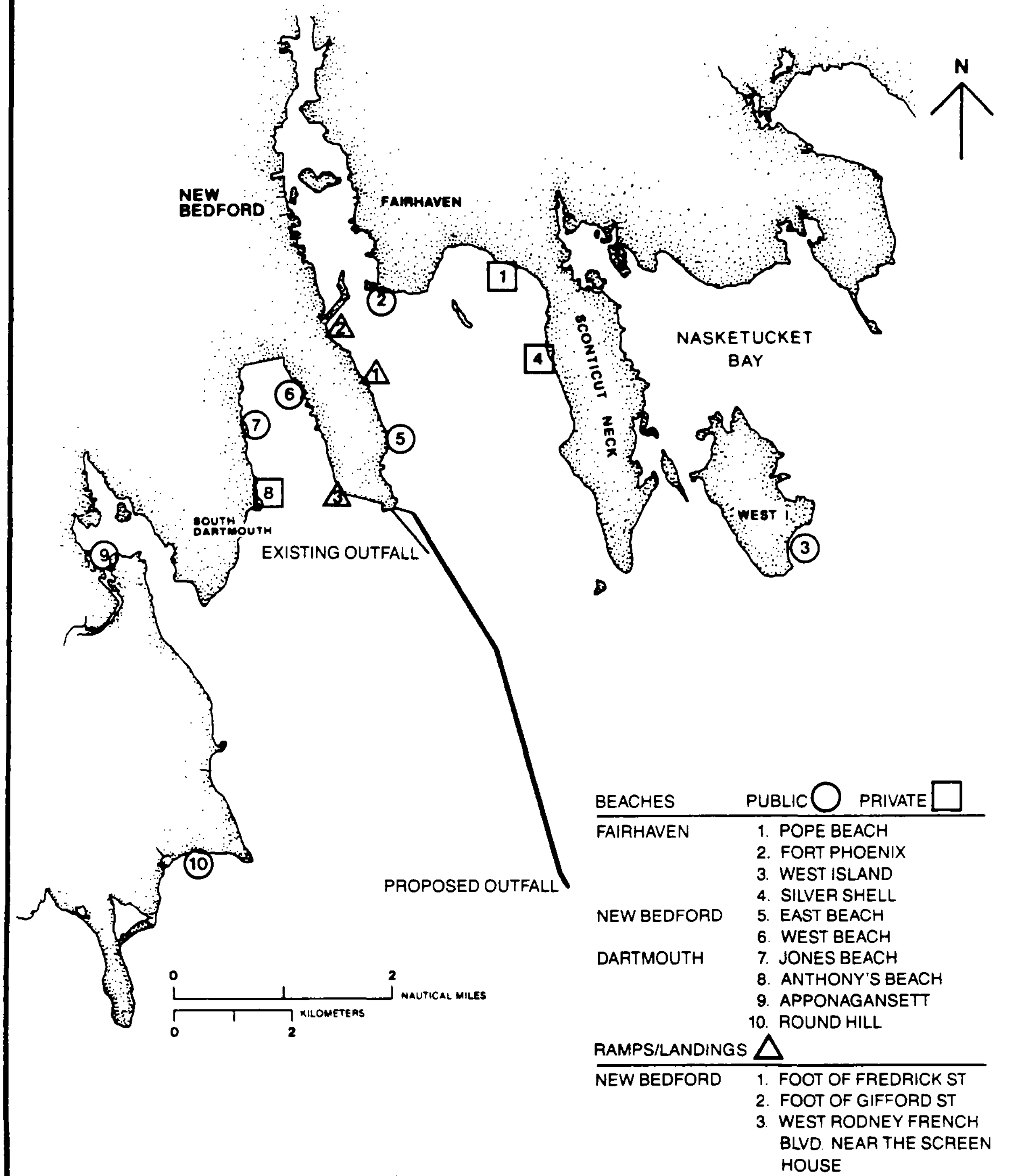
The applicant does not discuss presence or absence of a BIP of benthic infauna in relation to the stressed waters classification. Benthic infauna were not sampled at a stressed control site for the existing discharge. Thus, available data on infaunal community structure cannot be used to evaluate stressed conditions caused by sources of pollution other than the applicant's discharge. Nevertheless, it is clear that the existing discharge causes substantial modification of benthic community structure in the vicinity of the outfall. The existing discharge would contribute to further biotic degradation if perturbations from other sources increased, or it could retard recovery if such perturbations decreased. The modified discharge is not expected to contribute to, increase, or perpetuate stressed conditions near the existing outfall. Also, the modified discharge is not expected to retard recovery of the biota in New Bedford Harbor if perturbations from sources other than the applicant's discharge decrease.

The applicant also discusses the potential for violation of water quality criteria by discharges of copper. However, contamination by metals is not considered by the applicant as a cause of the stressed waters condition at the existing discharge site. Bioaccumulation of metals and its effects are discussed in Section III.D.4 above.

E. *Impacts of Discharge on Recreational Activities [40 CFR 125.61(d)]*

1. *Describe the existing or potential recreational activities likely to be affected by the modified discharge(s) beyond the zone of initial dilution.*

The applicant provides a brief description of existing and potential recreational activities in the coastal area within a radius of approximately 8 km (5 mi) of the proposed discharge site. The main recreational activities described by the applicant are swimming, wading, boating, and fishing. Two public beaches are located within an 8-km (5-mi) radius of the proposed discharge site: West Island Beach (Fairhaven) and Round Hill Beach (Dartmouth) (Figure 14). Eight other beaches are located in the general vicinity of New Bedford (Figure 14). Based on estimates provided to the applicant by the City of New Bedford Planning Department, the total use of seven of the 10 beaches in Figure 14 was 86,340 person-days during 1983. Estimates of visitor use were not available for Pope Beach, Fort Phoenix Beach, and Silver Shell Beach.



REFERENCE: NEW BEDFORD REVISED 301(h) APPLICATION, FIGURE IIE1

Figure 14. Locations of beaches and boat ramps/landings in the vicinity of New Bedford.

The applicant notes that outer New Bedford Harbor and Buzzards Bay are used extensively for recreational boating. The only boat ramp and landing located within an 8-km (5-mi) radius of the modified discharge is the one at West Rodney French Boulevard (Figure 14). The most extensive moorage facilities in the general area are located in inner New Bedford Harbor, where approximately 435 boats are moored.

Quantitative data are not available on the number of persons participating in recreational fishing. However, the applicant indicates that the major recreational species in outer New Bedford Harbor are scup (Stenotomus chrysops), bluefish (Pomatomus saltatrix), striped bass (Morone saxatilis), and Atlantic mackerel (Scomber scombrus) (also see above, Section II.C.3). Harvesting of scallops is permitted, although recreational harvesting of other shellfish is prohibited in the outer harbor (Figure 10) because of contamination by coliform bacteria.

2. *What are the existing and potential impacts of the modified discharge(s) on recreational activities? Your answer should include, but not be limited to, a discussion of fecal coliforms.*

Existing water quality standards for the Class SA waters in the vicinity of the proposed discharge state that total coliform bacteria concentrations shall not exceed a median value of 70 MPN/100 ml, and that no more than 10 percent of the samples taken in any monthly sampling period shall exceed 230 MPN/100 ml. In addition, the Massachusetts Department of Environmental Quality Engineering requires closure of any beach where total coliform bacteria concentrations exceed of 1,000 MPN/100 ml.

The applicant indicates that the existing outfall has had no adverse effects on swimming or wading at either East Beach or West Beach. However, Jones Beach and Anthony's Beach were closed on July 11, 1983, as a result of total coliform bacteria contamination from either the New Bedford Wastewater Treatment Plant or the combined sewer overflow at the upper end of Clarks Cove. The applicant states that estimates of the annual loading of total coliform bacteria contributed by the existing discharge is three orders of magnitude less than that from combined sewer overflows, dry weather overflows, and storm drains.

At present, the effluent discharged from the New Bedford Wastewater Treatment Plant is chlorinated. The applicant provides data on concentrations of total coliform bacteria in effluent collected on 22 dates between July, 1981, and June, 1983 (Table IIE3 of the revised application). The median concentration ranged from 0 to 510 MPN/100 ml, but none of the median values would have resulted in a violation of the standard (70 MPN/100 ml) assuming a minimum initial dilution of 26.5:1 for the modified discharge, as calculated during this review. Comparable data are not available for determining the potential for exceedance of the 230 MPN/100 ml standard in 10 percent of the samples. Using an initial dilution of 28:1, the applicant shows that the 230 MPN/100 ml standard would only have been exceeded on 38 days of a possible 623 days (or 6 percent of the time) during 1981-1983. Use of the 26.5:1 dilution calculated during this review would not likely change this conclusion. Therefore, assuming that the effluent quality achieved during the last 2 years can be maintained, violation of this standard by the proposed discharge is unlikely.

3. *Are there any Federal, State or local restrictions on recreational activities in the vicinity of the modified discharge(s)? If yes, describe the restrictions and provide citations to available references.*

Restrictions on recreational activities in the vicinity of the existing and modified discharges are primarily related to contamination of fisheries resources by coliform bacteria and PCBs (see above, Section III.D.3). The existing outfall is located in an area that is closed to harvesting of bottom-feeding fishes and lobsters because of PCB contamination. Since 1971, part of this area has been closed to harvesting of hardshell clams because of coliform bacteria contamination. On November 28, 1983, after preparation of the revised application, the area closed to shellfish harvesting was expanded (Figure 10 above).

4. If recreational restrictions exist, would such restrictions be lifted or modified if you were discharging a secondary treatment effluent?

Existing restrictions on recreational activities would probably not be affected if the New Bedford Wastewater Treatment Plant were discharging a secondary treatment effluent. The applicant provides letters from state agencies regarding lifting of recreational restrictions. Gerald S. Parker of the Massachusetts Department of Public Health indicated that extension of the outfall would not change the status of the present restrictions because "The amount of PCBs being discharged from the outfall at the present time has very little impact on the levels found in lobsters and bottom feeding fin fish in the harbor." Supporting data for this statement are not provided. Thomas C. McMahon of the Massachusetts Department of Environmental Quality Engineering indicated that the existing restrictions will remain in effect until the problem of PCB contamination has been resolved. He stated further that PCB contamination in the New Bedford area is not solely related to the level of treatment of the present discharge. Neither letter addressed restrictions on the harvest of shellfish which have been imposed due to contamination by coliform bacteria. Since sources of coliform bacteria other than the existing discharge are primarily repsonsible for these restrictions, the level of treatment of the New Bedford Wastewater Treatment Plant is not likely to affect these restrictions.

F. Establishment of a Monitoring Program (40 CFR 125.62)

1. Describe the biological, water quality, and effluent monitoring programs which you propose to meet the criteria of 40 CFR 125.62.

Biological

The applicant's proposed biological monitoring program includes bioaccumulation studies and field sampling of phytoplankton, benthic infauna, and fishes. The applicant also indicates that in conjunction with the benthic infaunal sampling and bioaccumulation studies, additional sediment samples will be collected for analysis of physical and chemical characteristics. The applicant does not provide a rationale for the choice of studies to be included in the biological monitoring program. Nevertheless, the types of studies proposed by the applicant are appropriate and should generally provide adequate data for monitoring the effects of the existing and proposed discharges. The applicant proposes to conduct two types of bioaccumulation studies: in-situ mussel (Mytilus edulis) bioassays and analyses of contaminants in muscle tissue of winter flounder (Pseudopleuronectes americanus). For reasons discussed below, the bioaccumulation studies proposed by the applicant should be modified to include analyses of contaminants in tissues of indigenous invertebrates.

Mussel bioassays are a valuable component of the proposed monitoring program. Results of in-situ bioassays will indicate water-column conditions in the immediate vicinity of the discharge, while reflecting any changes in effluent quality. However, mussel bioassays can provide only an indirect estimate of the potential for bioaccumulation and possible effects of abnormal body burdens of toxic substances. Moreover, benthic communities are affected by conditions in the sediments as well as conditions in the water column. Therefore, it is recommended herein that the applicant conduct analyses of contaminants in samples of indigenous invertebrates, e.g., Mercenaria mercenaria, as a supplement to the mussel bioassays. Although no Mercenaria were found at the proposed discharge site in the applicant's 1983 benthic survey, additional sampling using an efficient sampling device (i.e., benthic dredge) may reveal a sufficient population for the bioaccumulation study. If the applicant decides to use an indigenous species other than Mercenaria mercenaria, or to use data from another source (e.g., ongoing studies of PCB bioaccumulation in lobsters conducted by the Massachusetts Division of Marine Fisheries), sufficient rationale should be provided to justify the alternative design of the bioaccumulation study.

Further evaluation of the applicant's proposed biological monitoring program and specific recommendations are found in the response to the following question.

Water Quality

The applicant proposes water quality monitoring stations at 12 locations:

- Five near the existing discharge
- A shallow-water control station for the existing discharge
- Five near the proposed discharge
- A deep-water control station for the proposed discharge.

Monitoring at the existing discharge site and shallow-water control station will be discontinued 1 year after the outfall is relocated. Monitoring at the proposed discharge site and deep-water control station will begin 1 year before the modified outfall begins operation. Depth profiles of dissolved oxygen, pH, temperature, and salinity will be obtained at 1.5-m (5-ft) intervals throughout the water column. Additional duplicate samples, collected with a Van Dorn sampler near the surface, mid-depth, and bottom, will be analyzed for the following:

- Biochemical oxygen demand (BOD_5)
- Total suspended solids
- Turbidity
- Oil and grease
- Total nitrate and nitrite nitrogen
- Total ammonia nitrogen
- Total Kjeldahl nitrogen

- Total phosphorus

- Total coliform bacteria.

The receiving water also will be visually examined for discoloration. Fecal coliform bacteria and settleable solids should be included in the list of monitored parameters.

Effluent

The applicant proposes a program of influent and effluent monitoring at the New Bedford wastewater treatment facility. Conventional parameters to be monitored include BOD_5, settleable solids, suspended solids, oil and grease, and pH, but the application does not specify whether all of these parameters will be measured in both influent and effluent samples. No schedule for conventional pollutant influent and effluent sampling is provided other than to indicate that the parameters will be measured at the time of toxic pollutant sampling. Influent should be monitored for all of the conventional parameters specified by the applicant, along with continuous flow measurement. The list of effluent parameters should be expanded to include volumetric flow rate, dissolved oxygen, temperature, total and fecal coliform bacteria, and total chlorine residual.

The applicant proposes analysis of all priority pollutants in three 24-h flow-proportioned effluent samples annually. Samples would be collected during wet-, dry-, and average-flow conditions and analyzed for all EPA priority pollutants except asbestos.

> 2. *Describe the sampling techniques, schedules, and locations, analytical techniques, quality control and verification procedures to be used.*

Biological

Phytoplankton--

The applicant proposes to monitor phytoplankton at 8 sites in the vicinity of the existing and proposed discharges, as well as in two reference areas (Figure 15). Four stations will be located in the area of the existing discharge: two ZID-boundary stations on either side of the discharge, and two farfield stations 0.5 km (0.3 mi) from the ZID boundary. Four stations will also be located in the area of the improved discharge: two ZID-boundary stations on either side of the diffuser, and two farfield stations located 1.0 km (0.6 mi) from the center of the ZID. The remaining two stations will be located at the nearshore and offshore reference sites. Station locations selected by the applicant are appropriate.

Replicate samples will be taken at four depths at each station [surface, 1.0 m (3.3 ft), 3.0 m (9.8 ft), and 5.0 m (16.4 ft)]. Sampling will be conducted bimonthly in March, May, July, September, and November. It should be noted that major peaks in abundance of a regionally-dominant diatom (*Skeletonema costatum*) may occur in mid-winter (Smayda 1957; Staker and Bruno 1978). Therefore, it is recommended that the applicant sample in late January or February rather than in March. The applicant indicates that sampling will be conducted at all locations prior to discharge of effluent through the proposed outfall, but will be discontinued at the existing site thereafter. However, the applicant should continue sampling at the existing site for 1 yr following implementation of the proposed discharge. This extended sampling period is intended to complement the applicant's proposed sampling of benthic infauna and fishes in the vicinity of the existing discharge. Presumably, the purpose of such a sampling strategy is to document mitigating effects at the existing site of relocating the discharge to the proposed site.

Procedures for collection, processing, and analyses of samples generally follow those outlined by Stofan and Grant (1978), and are for the most part appropriate for quantitative characterization of the phytoplankton community. However, several points merit further consideration. The applicant

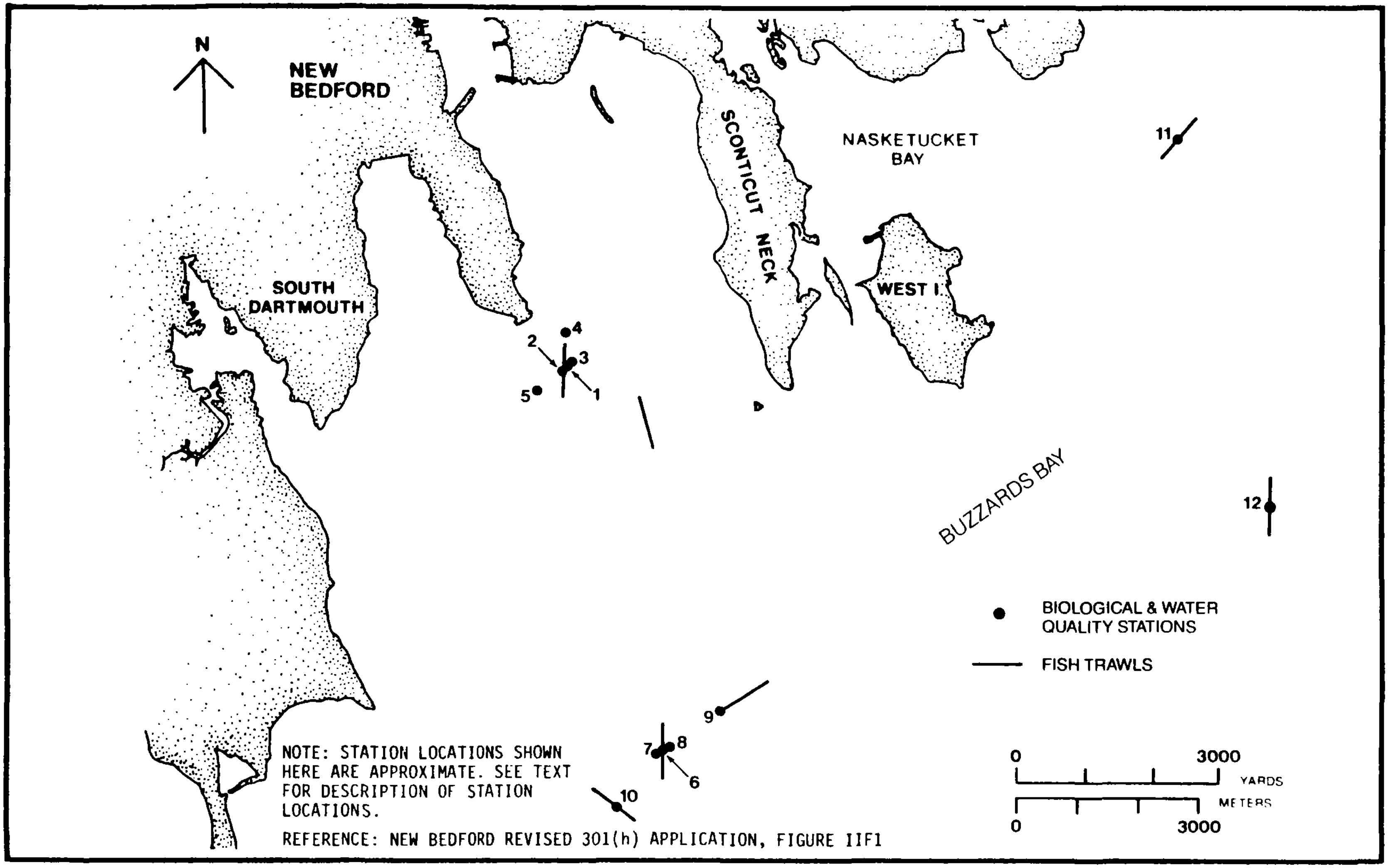


Figure 15. Proposed sampling station locations for New Bedford's 301(h) monitoring program.

proposes to use buffered formalin as a fixative. This is appropriate for diatoms and thecate dinoflagellates, but gives poor fixation of flagellates. Given the relative importance of flagellates in the present study, the applicant should consider using a different fixative such as Lugol's solution. Also, the applicant proposes to calculate descriptive indices of species diversity, evenness, and richness for each station. Although specific indices are not mentioned, the approach is appropriate as a first approximation in characterization of the phytoplankton community. However, the applicant should also use numerical classification in characterization of community structure because of the spatial, temporal, and biological complexity of the variables involved (Boesch 1977).

The applicant's proposed quality assurance and quality control program will consist of a voucher collection of photographs of representative specimens of each phytoplankton species and its identification to the lowest taxon. The applicant does not describe the necessary methods for temporary or permanent mounting of specimens that will give sufficient morphological and cytological detail to render an accurate and clear photograph. Questions that should be addressed are adequacy of fixation, clearing, mounting, microscopic resolution, and photographic image magnification, especially for smaller naked flagellates and dinoflagellates. Additional QA/QC procedures that should be incorporated into the applicant's phytoplankton monitoring program include:

- A systematic log-in and log-out procedure to ensure that samples are not lost, and to provide a record of chain of custody

- Resettling and recounting of 10 percent of the samples to ensure consistency in taxonomic identification and estimates of abundance

- Archiving of samples for later reference

- Review of laboratory data sheets by a taxonomic supervisor to ensure completeness in organism identification and data recording

- Verification of difficult or questionable taxa by a taxonomic specialist.

Benthic Infauna--

The applicant provides a brief description of sampling methods, station locations, frequency of sampling, laboratory processing, data analysis, and quality assurance/quality control (QA/QC) procedures. Although the proposed benthic monitoring program is reasonably complete, minor revisions and additions are recommended below.

The applicant proposes to collect benthic infaunal samples at 12 stations (Figure 15). These stations include:

- Station 1 - located within the existing ZID

- Stations 2 and 3 - located immediately beyond the existing ZID, southwest and northeast of the existing outfall, respectively

- Stations 4 and 5 - located 0.5 km (0.3 mi) beyond the existing ZID boundary, north and southwest of the existing outfall, respectively

- Station 6 - located within the ZID at the proposed discharge site

- Stations 7 and 8 - located immediately beyond the ZID, southwest and northeast of the proposed discharge site, respectively

- Stations 9 and 10 - located 1.0 km (0.6 mi) from the center of the ZID, northeast and southwest of the proposed discharge site, respectively

- Stations 11 and 12 - control sites for the existing and proposed discharges, respectively.

Most of these stations coincide with sampling sites occupied during the 1983 survey (see Section II.C.1, Benthic Infauna, above). Therefore, the general rationale for placement of sampling stations during the earlier survey also applies to the proposed monitoring station locations. The 1983 survey data should be comparable to the monitoring data, allowing characterization of baseline conditions prior to diversion of effluent from the existing discharge site to the proposed discharge site.

According to Figures 2 and 15, the position of Stations 2 and 3 in the monitoring program have been changed slightly from those in the 1983 survey. The applicant should ensure that Stations 2 and 3 used in the 1983 study are also used during the monitoring program to allow collection of comparable data. No justification is provided for positioning beyond-ZID stations 0.5 km (0.3 mi) from the ZID boundary at the existing discharge site (Stations 4 and 5 in Figure 15). Since spatial resolution of improving conditions at the existing discharge site will not be as important as definition of spatial effects of the proposed discharge, it is recommended that Stations 4 and 5 be repositioned to locations 0.5 km (0.3 mi) northeast and southwest of the diffuser at the proposed discharge site. Previous studies suggested that impacts of the existing discharge were detectable up to at least 1.0 km (0.6 mi) north of the existing outfall. However, the improvements proposed by the applicant are expected to lead to less extensive impacts at the proposed discharge site. Thus, positioning of stations within the ZID, immediately beyond the ZID, at 0.5 km (0.3 mi) from the diffuser, and at 1.0 km (0.6 mi) from the diffuser should allow adequate definition of the areal extent of impacts at the proposed discharge.

The applicant's choice of a reference site for the proposed discharge (Station 12 in Figure 15) is appropriate. Because of the complex hydrography and varied sediment conditions throughout Buzzards Bay, however, the applicant should monitor benthic infauna at two reference sites for the proposed discharge. The additional reference site should be positioned north or northeast of Station 12 in a habitat similar to the proposed discharge area.

Proposed methods for the positioning of sampling stations are not described by the applicant. It is assumed herein that station location methods for the monitoring program will be similar to those used in the 1983 benthic survey. These methods are acceptable.

The applicant proposes to begin the benthic monitoring program 1 yr before initiation of the modified discharge. Benthic samples will be collected quarterly: March, June, September, and December. Monitoring at the existing discharge site will be discontinued when "an improving trend is seen," e.g., 1 or 2 years after cessation of the discharge.

The sampling schedule proposed by the applicant is generally adequate. Quarterly sampling will allow characterization of seasonal trends in benthic infaunal parameters. It is suggested that monitoring at the existing discharge site be continued until community indices (e.g., species richness, total infaunal abundance) and community structure are not significantly different from control conditions, or until conditions at the existing discharge site have stabilized (i.e., re-establishment of "stressed" biotic assemblages, resulting from pollution sources other than the existing discharge).

For benthic infaunal analyses, the applicant proposes to collect five replicate 0.1-m^2 (1.1-ft^2) sediment samples at each site using a chain-rigged van Veen grab sampler. An additional sediment sample will be collected for analysis of grain-size composition (i.e., percentages of gravel, sand, silt, and clay). Standard water quality parameters (i.e., water temperature, salinity, dissolved oxygen, and depth) will also be measured at each station. It is also recommended herein that some measure of the organic content of the sediments (e.g., total organic carbon, total volatile solids) be estimated.

After the results of the first monitoring survey are available, the applicant plans to evaluate the adequacy of using less than five replicate 0.1-m^2 (1.1-ft^2) samples to characterize benthic infaunal communities.

If less than five replicates appear suitable, and if approval is granted by the U.S. EPA, a reduced number of replicates will be collected thereafter. Although the general approach proposed by the applicant is appropriate, a description of statistical techniques to be used for evaluation of the degree of sample replication is not provided. Appropriate sensitivity tests for determining the minimum number of replicates that would adequately describe the benthic community and enable a reasonable level of statistical sensitivity can be found in Saila et al. (1976), Gonor and Kemp (1978), and Ginn and Grieb (1983). Based on the results of the 1983 benthic survey, five 0.1-m^2 (1.1-ft^2) replicates appear appropriate for the applicant's monitoring program. Other authors (e.g., Lie 1968; Holme and McIntyre 1971; Swartz 1978) have generally recommended that a total area of 0.5 m^2 (5.4 ft^2) be sampled for assessment of infaunal species composition in coastal and estuarine regions.

The applicant states that benthic grab samples will be sieved through a 0.5-mm (0.02-in) mesh screen and fixed in a buffered solution of 10 percent formalin. After 24-168 h in formalin, samples will be transferred to 70 percent ethanol. The applicant proposes to sort the benthic samples, or subsamples, using appropriate microscopic techniques. Organisms will be identified to the lowest possible taxon. A list of taxonomic references to be used in identifying species is provided in the revised application.

Sample collection and processing methods proposed by the applicant are generally adequate. The only modification recommended herein is that subsampling not be conducted and that entire samples always be sorted. Use of species count data from subsamples to estimate abundance would greatly complicate the statistical analysis and could introduce an additional source of error.

The applicant plans to determine the following parameters for the benthic infaunal samples: 1) species composition, 2) abundance, 3) trophic position and biomass, 4) dominance, and 5) species diversity. Mathematical formulae for community indices (dominance, diversity) are not provided. It is recommended herein that the Shannon-Wiener diversity index (H', log base 2), species richness (mean number of taxa per replicate sample), and evenness (J') be calculated separately for each site. Also, the applicant should analyze the abundances of individual species known to be indicators of organic enrichment (e.g., see Pearson and Rosenberg 1978).

The applicant indicates that analysis of variance (ANOVA) and the Student-Newman-Keuls test will be used to determine the statistical significance of differences in benthic infaunal abundance and other community variables among sampling stations. As in the 1983 benthic data analysis, the applicant should ensure that the data meet the assumptions of ANOVA before applying parametric techniques. The applicant states that "Non-parametric techniques will be used on all other data." The applicant also states that multivariate techniques (e.g., classification, ordination) will be used to relate biological variables to physical-chemical parameters. The clustering strategies used for normal and inverse classification should follow those used for analysis of the 1983 benthic data. Insofar as they are described, the data analysis techniques proposed by the applicant are adequate. The applicant should refer to Sokal and Rohlf (1969), Clifford and Stephenson (1975), Boesch (1977), Green (1979), and Gauch (1982) for detailed information on individual analytical techniques.

The applicant plans to ensure quality of the benthic data by using fully qualified personnel for sample sorting and species identification. Names and qualifications of taxonomists are not provided in the revised application, but will be recorded as part of the monitoring program documentation. The applicant should also consult with investigators at Woods Hole Oceanographic Institute to ensure that the most up-to-date, accurate taxonomic keys are used for species identifications. As part of quality assurance/quality control (QA/QC), the applicant proposes to construct a permanent voucher collection of representative specimens for each taxon identified.

Additional QA/QC procedures are not specified, although the applicant plans to develop a general QA/QC manual (see below, Bioaccumulation). Other QA/QC methods, which should be incorporated into the applicant's benthic monitoring program include:

- A sample labeling and log-in/check-out system to ensure that samples are not lost, and to permit samples to be traced while being processed

- Resorting of 10-20 percent of each sorted sample to ensure 95 percent efficiency in removal of organisms

- A review of all laboratory data sheets by a taxonomic supervisor to ensure completeness, accuracy, and consistency in organism identification and data recording

- Verification of difficult or questionable taxa by a taxonomic specialist.

Each of these quality assurance/quality control measures is necessary to ensure high quality benthic data, and should be adopted in the monitoring program. In addition, it is recommended herein that all replicate data (i.e., abundances of individual species) be appended to each monitoring report at the time of submittal.

Fishes and Epibenthic Macroinvertebrates--

The applicant proposes to conduct duplicate hauls of a 4.9-m (16-ft) otter trawl at seven locations. Gear selection, length and speed of trawl, and methods for sample processing are appropriate and generally follow those recommended by Mearns and Allen (1978).

The applicant proposes to sample at four offshore stations (Figure 15), each of which will be at the same depth as the proposed discharge site. A ZID station (6) is located parallel to the diffuser, and two farfield stations (9 and 10) are located 1.1 km (0.68 mi) and 1.5 km (0.93 mi) on either side of the diffuser. The fourth offshore station (12) is located about 10 km (6.2 mi) northeast of the improved discharge site. Three additional stations are located inshore (Figure 15). One station (2) is located at the existing discharge site, and a reference station (11) is located east of Nasketucket Bay about 10 km (6.2 mi) northeast of the existing discharge site and at the same depth as the existing discharge. The remaining station, which is not numbered, is located about 1.6 km (1.0 mi) southeast of the existing discharge site near the entrance channel to the outer harbor. The location of the unnumbered station is inappropriate and should be moved to a farfield site located in the vicinity of the nearshore MDMF trawls (Figure 2). Also, the orientation of trawl stations 9 and 10 should be changed so that they are parallel to trawl station 6. This orientation will allow the trawls to traverse the area beneath the discharge plume, yet remain equidistant from the diffuser (Figure 2). Trawls in this area need not parallel isobaths since the bottom topography in this area is such that no more than 1.0 m (3.3 ft) in depth would be gained or lost from one end of the trawl to the other.

The applicant proposes to establish baseline conditions by sampling each station monthly for 1 yr preceding effluent discharge through the proposed outfall. Thereafter, quarterly sampling would be conducted during the months of March, June, September, and December. However, the applicant makes contradictory statements concerning duration of sampling at the existing (i.e., nearshore) trawl locations, suggesting that "quarterly monitoring will be continued for two years following discharge of wastewater from the new outfall," and that "monitoring at the existing discharge will be discontinued when discharge from the modified outfall begins."

The frequency of sampling seems excessive. Therefore, it is herein recommended that the applicant sample less frequently but with greater replication (three vs. two replicates) to ensure an adequate sample size. Furthermore, little benefit will be gained from an intensive, high frequency sampling program during the period preceding discharge through the proposed outfall if it is not continued during the period following initiation of the proposed discharge. An additional disadvantage to the proposed high frequency of sampling is that it ignores seasonal patterns of fish migration and abundance. The low abundance of fishes in the winter months would require a much greater level of sampling effort to arrive at an adequate sample size than would that proposed by the applicant. Therefore, it is recommended that for 1 yr prior to discharge through the proposed outfall, as well as thereafter, the applicant sample semiannually by taking triplicate trawls at each site. Triplicate trawls are recommended for several reasons. Although the August and October trawls summarized in the revised application provided an adequate average sample size, the proposed discharge site and offshore control site were undersampled on several occasions. The increased sampling effort is further necessary because of the low abundance of winter flounder, which is a target species for bioaccumulation studies described below. Winter flounder were rarely captured with the Marinovich trawl employed in the previous studies in areas other than the existing discharge site. The Whiting trawl employed in the MDMF surveys, which samples a much larger area (see Section III.C.1), captured an average of six winter flounder per trawl in the fall, and 130 winter flounder per trawl in the spring. Therefore, even with triplicate hauls of the Marinovich trawl, it is unlikely that the applicant will be able to sample six winter flounder at each station throughout the year.

Trawling should be conducted in May and September. May is selected because it is a month of intense shoreward migration of many fishes, and coincides with peaks in abundance of flatfish species in a similar area, Narragansett Bay (Oviatt and Nixon 1973). It is also a period of high abundance of flatfishes in areas near the existing and proposed discharge sites, as shown by the MDMF data summarized by the applicant. September is a period of high abundance of juvenile scup and black sea bass that precedes the peak seaward migration of fishes in the later fall months. Semiannual sampling should continue at the existing discharge (i.e., nearshore) sites for 2 yr following discharge through the modified outfall. Thereafter, monitoring of fishes should be conducted at only the offshore sites.

Trawl-caught invertebrates were not reported in the applicant's 1983 data summary (see Section II.C.1), although it is possible that epibenthic invertebrates were not sampled by the Marinovich trawl. It is recommended that epibenthic invertebrates be included in the proposed monitoring program. The reason for this is the overwhelming economic importance of shellfish species to the total fisheries resource on the Atlantic coast (Charron 1980). Most notable in this regard are American lobsters.

Procedures for processing and handling of samples are generally acceptable. Fishes sampled by otter trawl will be weighed, measured (standard length), identified, and examined for symptoms of disease, parasitism, or abnormal coloring. However, no provision is made for internal examination of fishes for abnormalities of the digestive tract, liver, kidneys, and muscle tissue. The applicant should develop procedures for sampling fishes for disease or idiopathic tissue lesions should they become evident upon gross external and internal examination (Strange 1983).

The applicant proposes to calculate descriptive indices of species diversity, evenness, and richness for each station. Although specific indices are not mentioned, the approach is appropriate as a first approximation in characterization of the fish community. The applicant should also use numerical classification in characterization of community structure, because of the spatial, temporal, and biological complexity of the variables involved (Boesch 1977).

The applicant does not discuss quality assurance/quality control (QA/QC) procedures in the assessment of trawl-caught fishes and invertebrates. Therefore, QA/QC procedures that should be incorporated include:

- Systematic methods for field examination of fishes and criteria for taking additional samples for quantitative examination in the laboratory

- A collection of voucher specimens

- Provisions for verification of specimen identification by a taxonomic specialist.

Bioaccumulation--

Mussel Bioassays--The applicant plans to conduct mussel bioassays at six sites: Stations 1, 2, 6, 7, 11, and 12 (Figure 15). Bioaccumulation study sites correspond to locations within and immediately beyond the ZID at both the existing and proposed discharges, and two control sites. The proposed station locations are adequate.

The proposed bioaccumulation study will be conducted quarterly; i.e., March, June, September, and December. The bioassay testing will begin 1 yr before initiation of the proposed discharge. In the first year, only one station in the vicinity of the proposed discharge will be occupied. Bioassays will be discontinued at the existing discharge site after an "improving trend" is established (e.g., after 1-2 yr). The testing schedule proposed by the applicant is adequate.

The applicant proposes to collect *Mytilus edulis* from a single sampling site (location unspecified). A portion of the source population will be analyzed to determine contaminant concentrations before the bioassay exposure period. The applicant proposes to expose 10 mussels at each of two depths: 0.3 m (1 ft) off the bottom and the calculated depth of the plume trapping level [1.5 m (5 ft) to 3.0 m (10 ft) below the water surface]. After a 6-wk exposure period, organisms will be examined for mortality, growth in terms of shell length, and gross abnormalities. A composite tissue sample from each depth will be analyzed for mercury, cadmium, copper, chromium, nickel, lead, zinc, pesticides, and PCBs. A sediment sample from each site will be analyzed for each of the same contaminants. Further details of sampling and analytical methods are not provided by the applicant.

The proposed sampling and analytical procedures are generally adequate. However, replicate (at least duplicate) caged populations should be exposed at each depth at each site. This will enable the applicant to use statistical techniques to test for differences in survival and growth among sites. The deep exposure depth should be changed to 1 m (3 ft) off the bottom. The exposure depth proposed by the applicant [0.3 m (1 ft)] would place the mussels in close proximity to the sediments, which could influence the results by acting as a source of contaminants. The applicant should also include individual body weight (wet weight without shell) as a test parameter. The ratio of body weight to shell length provides a more sensitive index of condition than does shell length alone.

The list of contaminants proposed by the applicant is adequate at present. Any nonvolatile, priority pollutants that are detected in the effluent should also be included in the future. Because of the high cost of chemical analysis, the applicant may wish to retain the proposed procedure of analyzing a single composite sample from each exposure depth. The applicant should also measure total extractable lipid material of each mussel sample. Concentrations of organic contaminants can then be normalized to lipid content. The applicant should submit to the U.S. EPA a detailed description of apparatus and methods for the mussel bioassays, including deployment and retrieval equipment, selection of test organisms, cage design, and analytical techniques. Guidance on procedures for conducting in-situ mussel bioassays can be found in Stephenson et al. (1979), Phelps and Galloway (1980), and Bayne et al. (1981). Analytical chemistry techniques should follow guidelines established by U.S. EPA (1981).

The applicant proposes to analyze the data using "appropriate parametric, or...nonparametric statistics." Further description of the proposed statistical analyses is not provided. Note that the testing design proposed by the applicant does not include replicate units, and therefore would not provide data amenable to statistical analyses. Use of replicate test cages at each depth as recommended above would allow statistical analysis of survival, growth, and condition data. The general strategy for statistical testing should follow an ANOVA design (or a nonparametric analog) similar to that described in the Benthic Infauna section above. A two-way ANOVA is appropriate for the bioassay data, with exposure depth and station location as treatment factors. Further information on statistical analyses is provided in Sokal and Rohlf (1969), Green (1979), and Tetra Tech (1982a).

The applicant plans to develop a QA/QC manual, which will include the following elements:

- Sampling procedures

- Field log sheets

- Sample preservation and holding times

- Sample custody forms
- Equipment calibration and maintenance
- Analytical procedures
- Analytical quality control
- Data analysis procedures
- Personnel qualifications.

Further description of the QA/QC manual is not provided. The applicant should submit the QA/QC manual to the U.S. EPA for approval before initiation of the monitoring program.

Fish--The applicant proposes to analyze for contaminants in winter flounder tissue on a quarterly basis. Six winter flounder of about the same size (unspecified) will be selected from the trawl catch at each of the seven sampling sites (Figure 15). Muscle tissue from the six winter flounder will be removed and composited to form one sample for each site. Fish tissue samples will be analyzed for the same contaminants as those in mussel tissues (i.e., mercury, cadmium, chromium, copper, nickel, lead, zinc, pesticides, and PCBs). Further details of methods and data analyses are not provided.

The applicant's decision to incorporate analysis of contaminants in muscle tissue of winter flounder into the biological monitoring program is appropriate. However, several changes in the proposed study design are recommended herein. Suggested modifications in sampling schedule and station locations are presented in the section on Fish and Epibenthic Macroinvertebrates above. The sampling and analysis of contaminants in fish tissue should be conducted using specimens from each semiannual sampling period. Large, adult winter flounder should be selected for tissue analyses, because these individuals are the object of both commercial and recreational fisheries. Since the sampling design proposed by the applicant does not include sample replication, the results of the proposed program would not be suitable for statistical analysis. In this case, data analysis and interpretation would be extremely limited. Therefore, it is recommended that the applicant collect at least duplicate composite samples at each station. The results would then be amenable to statistical analyses such as two-way ANOVA or some nonparametric analog, which allow detection of differences among sites and among seasons.

The applicant does not describe specific analytical techniques and QA/QC procedures for sampling and analyses to be conducted as part of the fish bioaccumulation study. The applicant plans to develop a general QA/QC manual for the biological monitoring program. Recommendations for analytical methods and QA/QC are presented earlier in the section on mussel bioassays. The QA/QC manual proposed by the applicant should incorporate descriptions of methods (or citation of references describing methods) and QA/QC for the fish bioaccumulation study.

Water Quality

No description of receiving water sample collection methods is supplied in the revised application. Sample preservation and storage requirements are given in Table IIF2 of the revised application. It is recommended that the preservation procedures be modified to prescribe immediate measurement of total suspended solids and turbidity rather than preservation of the samples for later analysis.

The applicant proposes monthly water quality sampling from March to December. Throughout the first year of operation of the proposed outfall extension, sampling should be conducted monthly. Sampling frequency may then be reduced if a thorough analysis of the first year of data demonstrates that a reduction is warranted. Sampling depths should also be precisely specified. Recommended depths are 1 m (3.3 ft) below the water surface, mid-depth, and 1 m (3.3 ft) above the bottom. Sampling of dissolved oxygen, pH, temperature, and salinity at 1.5-m (5-ft) depth intervals is acceptable.

Monitoring stations near the proposed discharge consist of one within the ZID, two ZID boundary stations, and two 1 km (0.6 mi) northeast and southwest of the diffuser. A control station is located approximately 10 km (6.2 mi) east-northeast of the proposed outfall. The applicant intends to mark each station with a permanently-moored buoy. Longitude and latitude should be determined to the nearest second so that stations can be precisely charted and relocated if a buoy is lost or damaged.

Analytical procedures, precision, and detection limits, presented in Table IIF3 of the revised application, follow acceptable EPA methods or those described in American Public Health Association (1980), which are also acceptable. A precision limit for total coliform bacteria is not given in Table IIF3, but should be specified as a 95 percent confidence limit. The applicant should also specify the number of significant digits to be recorded to help ensure that precise data are obtained.

Details of quality assurance and quality control (QA/QC) procedures are not provided in the application. The applicant proposes to submit a QA/QC manual prior to the initiation of the monitoring program. The manual will include a description of sampling procedures, sample preservation procedures, sample custody, equipment calibration and maintenance, analytical procedures, analytical quality control, and procedures for data analysis. Guidance on the design of a satisfactory QA/QC plan may be found in Tetra Tech (1982a).

Effluent

Discussion in the revised application emphasizes the collection of priority pollutant samples. Details of conventional pollutant sample collection are omitted. Toxic pollutant samples will be collected with an automatic sampler equipped for priority pollutant sampling, or, alternatively, hourly grab samples will be collected and composited manually in proportion to plant flow. Sample containers, preservation techniques, and maximum hold times, listed in Table IIF4 of the revised application, are taken from U.S. EPA (1979a), and are acceptable. Influent samples will be collected downstream of the grit chamber, and effluent samples will be collected downstream of the primary settling tanks and after chlorination.

Annual wet-weather, dry-weather, and average-flow samples are proposed for priority pollutant analyses. In addition, the applicant proposes that samples collected on consecutive days will be analyzed for compounds representative of wastes discharged in the service area. In light of the industrial character of the service area, additional priority pollutant sampling is suggested, particularly if toxic pollutant concentrations are found to fluctuate widely over time. In view of the findings of Dunn (19 March 1984, personal communication), as discussed below (Section III.H.2), it may be more appropriate to composite samples over longer than a 24-h period to obtain representative results. A conventional pollutant sampling schedule must also be developed. Continuous flow monitoring of influent and effluent is recommended. Hourly and average daily flow rates should be recorded. Daily influent and effluent BOD_5 and suspended solids samples should be collected (preferably 24-h flow-composite samples). Daily pH measurements should be conducted at different times each day. Daily grab samples for total and fecal coliform bacteria are recommended. Daily measurement of all other influent and effluent conventional parameters is also suggested, as these data can be useful in monitoring treatment plant operation.

Acceptable analytical techniques for priority pollutant analyses are listed in Table IIF5 of the revised application. Acceptable conventional pollutant analytical methods are given in Table IIF6 of the revised application. These methods are identical to those described in U.S. EPA (1979b).

Details of QA/QC procedures for effluent and influent monitoring are not provided in the revised application. The applicant acknowledges that the laboratory performing toxic pollutant analyses must have an acceptable quality assurance plan, consisting of chain-of-custody records, equipment calibration and maintenance procedures and schedules, documented analytical procedures, a schedule of duplicates, blanks, splits, and spikes, and other quality control procedures. QA/QC records will be provided as part of the annual monitoring reports. Laboratories performing analyses will be certified by the Commonwealth of Massachusetts.

3. *Describe the personnel and financial resources available to implement the monitoring programs upon issuance of a modified permit and to carry it out for the life of the modified permit.*

The revised application does not include description of the personnel and financial resources available to implement the monitoring programs.

G. *Effect of Discharge on Other Point and Nonpoint Sources (40 CFR 125.63)*

1. *Does (will) your modified discharge(s) cause additional treatment or control requirements for any other point or nonpoint pollution source(s)?*

The applicant states that no other discharges are located within 3.2 km (2.0 mi) of the proposed discharge. The nearest land is Round Hill Point, approximately 4.2 km (2.6 mi) from the proposed discharge. Therefore, there are no land-based nonpoint pollution sources in the vicinity of the proposed discharge.

2. *Provide the determination required by 40 CFR 125.63(b) or, if the determination has not yet been received, a copy of a letter to the appropriate agency(s) requesting the required determination.*

The applicant provides a copy of the letter sent to the Massachusetts Division of Water Pollution Control on December 2, 1983, requesting the required determination. A reply was not available for comment at the time of this review (Ledger, B., 8 March 1984, personal communication).

H. *Toxics Control Program (40 CFR 125.64)*

1. *Do you have any known or suspected industrial sources of toxic pollutants or pesticides?*

The applicant states that 203 business operations were identified as pretreatment candidates in its 1983 Industrial Pretreatment Report. Of these, 41 are included in EPA pretreatment categories and represent potential sources of toxic pollutants or pesticides. Limited sampling identified priority pollutants in many of these industries. Data on mass loadings of metals from 17 industrial, commercial, and nonpoint sources are given in Table 11. The applicant expects reduced loadings of some of the identified toxic pollutants after implementation of pretreatment regulations, but does not estimate the degree of the reduction. Continuation of the declining trend in industrial flows (discussed in Section II.A.5) suggests that even without pretreatment measures, toxic pollutants from industrial sources will decrease. However, the declining trend in industrial flows appears to be based on estimated 1974 industrial flows that may not be supported by measured flow data. This, along with the lack of data on trends in industrial waste strength, make it difficult to predict trends in industrial toxic pollutant inputs to the treatment plant.

2. *Provide the results of wet and dry weather effluent analyses of toxic pollutants and pesticides as required by 40 CFR 125.64(a)(1).*

The applicant presents the results of toxic pollutant analyses of dry- and wet-weather samples collected in 1983. No significant rainfall was reported by the applicant for 5 days preceding the dry-weather sample. The wet-weather sample was collected within 5 days of significant rainfall. Supporting rainfall data are provided in the revised application. The detected priority pollutants and their concentrations are given in Table 2 of Section II.A.3 above. In addition to the 1983 test results, the revised application contains the results of previous toxic pollutant analyses conducted in 1979.

The results of influent and effluent analyses are presented in Table IIH1 of the revised application. The numbers of detected metals and inorganic

TABLE 11. CURRENT COMPARISON OF ANNUAL INDUSTRIAL LOADINGS FOR SELECTED METALS[a]

Company	Cadmium lb/yr	Chromium lb/yr	Copper lb/yr	Lead lb/yr	Nickel lb/yr	Zinc lb/yr
Acushnet Company	0	0	0	52	416	11,902
Alberox Corp.	0	0	0	0	104	0
Brittany Dyeing Printing Corp.	72	0	381	113	0	348
Chamberlain National Corp.	0	0	111	0	0	355
Continental Screw Co.	0	276	178	0	0	276
Cornell-Dubilier Electronics	0	0	0	0	0	2
Dartmouth Finishing Corp.	2	0	650	52	0	169
EPEC Inc.	0	0	491	765	0	22
Fibre Leather Mfg. Corp.	0	0	183	0	0	4
Gulf & Western Mfg. Co.	0	0	0	0	0	19
Isotronics Inc.	0	0	109	0	191	1
Paulding, John Inc.	0	9	0	28	0	46
Payne Cutlery Corp.	0	639	0	0	119	0
Schaefer Marine Inc.	0	77	6	26	35	0
Star Plating Co., Inc.	92	2,345	2,429	5	14,243	0
Teledyne Rodney	0	0	0	6	0	0
Urban Runoff Contribution	8	59	170	1,789	102	1,022
Total:	174	3,405	4,708	2,836	15,210	14,166

[a] Estimated loadings based on flow and waste stream data for industries obtained during the survey conducted for the Industrial Pretreatment Program. The data are considered very preliminary and are shown for illustrative purposes only.

Source: City of New Bedford revised 301(h) application (1983).

priority pollutants, as well as the numbers of organic priority pollutants are summarized as follows:

Sample Date	Number of Metals and Inorganic Priority Pollutants Detected	Number of Organic Compounds Detected
April 4-9, 1979 effluent wet-weather	14	44
May 9-10, 1979 effluent	14	49
June 3-8, 1979 influent	14	9
June 3-8, 1979 effluent	14	8
June 15-16, 1983 effluent dry-weather	14	4
August 11-12, 1983 effluent wet-weather	14	4

As part of the evaluation of the original New Bedford 301(h) application (Tetra Tech 1981), the concentrations of five pollutants (endosulfan, PCBs, copper, mercury, and cyanide) were found to exceed available saltwater criteria (Table 12) following initial dilution. Concentrations following initial dilution were determined from the maximum effluent concentrations of the April and May, 1979, sample analyses subject to an initial dilution

TABLE 12. SUMMARY OF FEDERAL EPA WATER QUALITY CRITERIA

Compound	24-h Saltwater Aquatic Life Criteria (ug/l)	Chronic Saltwater Aquatic Life Criteria (ug/l)	Acute Saltwater Aquatic Life Criteria (ug/l)	Not to Exceed at Any Time (ug/l)
Acenaphthene	a	710	970	a
Acrolein	a	a	55	a
Acrylonitrile	a	a	a	a
Aldrin	a	a	a	1.3
Dieldrin	0.0019	a	a	0.71
Antimony	a	a	a	a
Arsenic	a	a	508	a
Asbestos	a	a	a	a
Benzene	a	700	5,100	a
Benzidine	a	a	a	a
Beryllium	a	a	a	a
Cadmium	4.5	a	a	59
Carbon tetrachloride	a	a	50,000	a
Chlordane	0.0040	a	a	0.09
Chlorinated benzenes	a	129	160	a
Chlorinated ethanes	a	a	a	a
1,2-dichloroethane	a	a	113,000	a
1,1,1-trichloroethane	a	a	31,200	a
1,1,2,2-tetrachloroethane	a	a	9,020	a
Pentachloroethane	a	281	390	a
Hexachloroethane	a	a	940	a
Chlorinated naphthalene	a	a	7.5	a
Chlorinated phenols	a	a	a	a
2,3,5,6-tetrachlorophenol	a	a	440	a
4-chlorophenol	a	a	29,700	a
Chloroalkyl ethers	a	a	a	a
Chloroform	a	a	a	a
2-chlorophenol	a	a	a	a
Chromium	a	a	a	a
Trivalent chromium	a	a	10,300	a
Hexavalent chromium	18	a	a	1,260
Copper	4.0	a	a	23
Cyanide	a	2.0	30	a
DDT and Metabolites	0.0010	a	a	0.13
TDE	a	a	3.6	a
DDE	a	a	14	a
Dichlorobenzenes	a	a	1,970	a
Dichlorobenzidines	a	a	a	a
Dichloroethylenes	a	a	224,000	a
2-dichlorophenol	a	a	a	a
Dichloropropanes	a	3,040	10,300	a
Dichloropropenes	a	a	790	a
2,4-dimethylphenol	a	a	a	a
2,4-dinitrotoluene	a	a	590	a
1,2-diphenylhydrazine	a	a	a	a
Endosulfan	0.0087	a	a	0.034
Endrin	0.0023	a	a	0.037
Ethylbenzene	a	a	430	a
Fluoranthene	a	16	40	a
Haloethers	a	a	a	a
Halomethanes	a	6,400	12,000	a
Heptachlor	0.0036	a	a	0.053
Hexachlorobutadiene	a	a	32	a
Hexachlorocyclohexane	a	a	a	a
Lindane	a	a	a	0.16
BHC	a	a	0.34	a
Hexachlorocyclopentadiene	a	a	7.0	a
Isophorone	a	a	12,900	a
Lead	a	25	668	a
Mercury	0.10	a	a	3.7
Naphthalene	a	a	2,350	a
Nickel	7.1	a	a	140
Nitrobenzene	a	a	6,680	a
Nitrophenols	a	a	4,850	a
Nitrosamines	a	a	3,300,000	a
Pentachlorophenol	a	34	53	a
Phenol	a	a	5,800	a
Phthalate esters	a	a	2,944	a
Polychlorinated biphenyls	0.030	a	a	a
Polynuclear aromatic hydrocarbons	a	a	300	a
Selenium	54	a	a	410
Silver	a	a	a	2.3
Tetrachloroethylene	a	450	10,200	a
Thallium	a	a	2,130	a
Toluene	a	5,000	6,300	a
Toxaphene	a	a	a	0.070
Trichloroethylene	a	a	2,000	a
Vinyl chloride	a	a	a	a
Zinc	58	a	a	170

[a] No established standard.

of 60:1. Applying an initial dilution of 26.5:1 (the critical initial dilution calculated for the modified diffuser as part of this review), two additional priority pollutants (cadmium and nickel) also exceed the available saltwater criteria following initial dilution. Fewer priority pollutants have been detected in samples collected since May, 1979. From the effluent samples tested since May, 1979, copper was the only quantifiable priority pollutant exceeding available saltwater criteria following a minimum initial dilution of 26.5:1. However, due to the uncertainty in actual concentrations brought about by the high detection or quantitation limits, PCBs, mercury, and nickel may also exceed the criteria (see Section II.A.3 and Table 2). It should also be noted that details of sample containers, collection methods, and storage are not described in the revised application. Thus, it is not known if acceptable procedures were followed, and what effects, if any, these procedures had on the analytical results.

PCBs in concentrations ranging from 0.7 ug/l to 5.7 ug/l were detected during tests of the treatment plant effluent conducted by the Massachusetts Division of Water Pollution Control in March, 1982 (Weaver 1982). Analyses of two more samples in June, 1982, yielded PCB concentrations of 6 ug/l and 10 ug/l (Weaver, G., 16 March 1984, personal communication). Since that time, cleanup operations at the PCB-contaminated Aerovox and Cornell-Dubilier industrial sites have significantly reduced (but not eliminated) the entrance of PCBs to the treatment plant (Dunn, D., 19 March 1984, personal communication). Since no PCBs were detected, the applicant provides the results of the dry- and wet-weather effluent toxic substances sampling of 1983 as evidence of a lowering of PCB concentrations. However, as noted in Section II.A.3 above, detection limits were too high to detect concentrations that may still violate EPA water quality criteria. Furthermore, the results of two 24-h composite samples should not be taken as conclusive evidence of elimination of PCBs from influent and effluent. Dunn (19 March 1984, personal communication) found that more representative PCB test results could be obtained at the New Bedford Wastewater Treatment Plant by compositing samples over a 5-day period. He based his conclusions on the correlation between influent and effluent PCB concentrations observed during the 1982 sampling conducted by the Massachusetts Division of Water Pollution Control. The longer compositing period was believed to be necessary to reduce variation caused by frequent fluctuations in treatment plant efficiency. Therefore, while it appears that effluent PCB concentrations have been lowered, conclusive data on the degree of PCB contaminant reduction are not yet available.

3. *Provide an analysis of known or suspected industrial sources of toxic pollutants and pesticides identified in 2. above.*

Possible industrial and commercial sources of organic compounds are given in Table IIH3 of the revised application and are reproduced herein in Table 13. In addition, the sources of toxic metals can be inferred from the preliminary data presented in Table 11.

4. *Do you have an approved industrial pretreatment program?*

A final report on the City of New Bedford's industrial pretreatment program was submitted in December, 1983, to EPA Region I. A final decision on the acceptability of the program is pending (Potamis, J., 9 March 1984, personal communication).

5. *Describe the public education program you propose to minimize the entrance of nonindustrial toxic pollutants and pesticides into your treatment system.*

The applicant proposes to develop toxicant source control programs that will incorporate both structural and non-structural alternatives. The public information program would fall under the domestic source control program, and would consist of efforts to minimize the use of toxic pollutants and to encourage their proper disposal. Collection programs to gather waste chemicals and containers would be instituted.

6. *Provide a schedule for development and implementation of nonindustrial toxics control programs to meet the requirements of 40 CFR 125.64(d)(3).*

The applicant provides schedules for the development and implementation of a nonindustrial source control program for the service area of the New

TABLE 13. POSSIBLE SOURCES OF COMPOUNDS DETECTED IN NEW BEDFORD WASTEWATER TREATMENT PLANT EFFLUENT

Compound	Concentration (ug/l) June 1983 Dry Weather	Concentration (ug/l) August 1983 Wet Weather	Possible Source of Compound
1,1,1-trichloroethane	34	14	Dartmouth Facility
chloroform	ND	7	Acushnet Co., Brittany Dyeing Printing Co. Dartmouth Finishing Corp., Fibre Leather Mfg.
ethylbenzene	19	ND	Brittany Dyeing Printing Co. Dartmouth Finishing Corp.
bis (2-ethylhexyl) phthalate	70	21	Unknown source
di-n-octyl phthalate	13	ND	Unknown source
tetrachloroethylene	ND	6	Unknown source
toluene	20	26	Fiber Leather Mfg.
trichloroethylene	20	8	Unknown source

Source: City of New Bedford revised 301(h) application (1983).

Bedford Wastewater Treatment Plant. The schedules specify full implementation of the program within 18 months of approval of a 301(h) waiver.

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